

BIGHORN NATIONAL FOREST

Final Environmental Impact Statement

for the

Revised Land and Resource Management Plan

Affected Environment
and
Environmental Consequences

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Purpose and Organization of this Chapter

Chapter 3 contains a description of the Affected Environment and Environmental Consequences. The primary purpose of this chapter is to describe the environment of the Forest and to disclose the effects of the alternatives.

This chapter contains a description of the physical, biological, and social environments on the Forest and the surrounding area. These descriptions include such topics as geology, topography, climate, plant and animal life, and current socio-economic conditions. The chapter is divided into five major environmental element categories:

- ◆ Physical Elements.
- ◆ Biological Elements.
- ◆ Use and Designation of the Forest.
- ◆ Utilization of Natural Resources.
- ◆ Communities.

Each category is further subdivided. For example, Physical Elements is subdivided into four topics: air, aquatic resources, heritage resources, and soils. For each topic, the applicable statutory requirements, and the affected environment and environmental consequences are discussed.

Many additional items were screened out of the analysis process. The reasons for eliminating them include the following:

- ◆ Analysis of the item was not considered important to the integrity of the Forest environment.
- ◆ Analysis of the item would not disclose direct or indirect effects of the Forest Plan to the environment.
- ◆ Analysis of the item was not acknowledged or required by law.

Resource Protection Measures

Programmatic plan direction is an integrated set of 'design criteria' that will guide subsequent project-level NEPA planning. The design criteria in the Revised Forest Plan includes strategies, standards, and guidelines. Mitigation measures may be used in the project-level planning, as appropriate.

Environmental Consequences

This section describes the direct, indirect, and cumulative effects on the environment resulting from activities. It also describes *estimated* output levels for the alternatives. If a resource management activity has no direct or indirect effect on a particular environmental element (listed above) under any of the alternatives, there is no discussion. Each of these effects is discussed under the individual resource headings (e.g., Air, Heritage, Wildlife, etc.) in this chapter. Cumulative effects are also summarized below in Table 3-1.

Direct environmental effects are those that occur at the same time and place as the initial action. An example would be on-site soil compaction from rubber-tired skidders harvesting timber. **Indirect environmental effects** are caused by the action, but occur later in time or are spatially removed from the action. An example would be downwind effects of a power plant on air quality.

Cumulative effects are a combination of direct and indirect effects of an alternative combined with the effects of past, present, and foreseeable future activities undertaken by either the Forest Service or other parties. In each resource section in this chapter, the cumulative effects discussion defines the cumulative effects analysis area for the resource and how each cumulative effects analysis is bounded in time. Unless a different time period is defined, reasonably foreseeable future actions are considered for the expected life of the Revised Plan (10-15 years into the future). Since the Bighorn Revised Plan is a programmatic document, the reasonably foreseeable actions considered are also largely programmatic in nature.

The cumulative effects estimated in the FEIS are negligible, and there is no substantive variance by alternative. The cumulative effects boundary for this discussion is the Bighorn Basin, Powder River Basin, and Big Horn Mountains. The time considered is the life of the Revised Plan, which is expected to be 10-15 years. The effects are summarized in Table 3-1. Because of the different resources involved and different effects measurements,

this is not a quantitative discussion, but a narrative of the Revised Plan's cumulative impact upon the environment.

Table 3-1. Past and reasonably foreseeable actions for the cumulative effects analysis.

Project/Action	Location	Description
Past Activities		
Forest vegetation treatment	Forestwide	<p>1. Acres and locations of past timber harvest and fires are shown in the Geographic Area and Forest wide analyses, and the fire and forest vegetation white papers.</p> <p>Approximately 20% of the forested acres on the Bighorn NF have had harvest activities in them, with only 4% totaling clearcuts (Meyer, et al, 2003)</p> <p>2. The current condition of the forests resulting from the past natural events and planned activities is described in the current vegetation database. For example, recent fires are coded as Habitat Structural Stage 1T, clearcuts from the 1960s are typically 3A or 3B, which indicates current stand size and density.</p>
Fire suppression	Forestwide	Fire suppression activities have changed fire regimes and condition classes, particularly in sagebrush, ponderosa pine, and Douglas-fir vegetation types, though also aspen to some extent. This is fully documented in the fire/fuels section of Chapter 3.
Roads	Forestwide	<p>The history, current status and management of the Bighorn NF Road System is described in:</p> <p style="padding-left: 40px;">The forestwide Roads Analysis.</p> <p style="padding-left: 40px;">The Geographic Area and forestwide assessments.</p> <p style="padding-left: 40px;">The Heritage and Engineering specialist's reports.</p> <p style="padding-left: 40px;">Road densities and stream crossings as assessed in the Terrestrial and Aquatic Ecosystem Assessments.</p>
Livestock grazing	Forestwide	Historically high numbers of livestock grazed on Forest that have decreased over the past century for a variety of carrying capacity, economic, and industry related issues. Improvements in upland and riparian vegetation communities have occurred since.
Non-native species	4-county area	<p>1. Accidental and/or purposeful introductions of noxious weeds and non-native vegetation leading to loss of native vegetation communities.</p> <p>2. Accidental and/or purposeful introductions of non-native animals (insects, pathogens, fish, mammals) that have replaced some native species or caused decline of some (e.g. trout and amphibians/macroinvertebrates, white pine blister rust, biological control of noxious weeds, moose, honey bees, etc.).</p>

CHAPTER 3
AFFECTED ENVIRONMENT & ENVIRONMENTAL CONSEQUENCES

Project/Action	Location	Description
Loss of predators	North central Wyoming	<p>1. Extirpation of grizzly and wolves from the Forest following settlement of the area.</p> <p>2. In conjunction with game protection laws, increase in big game herds.</p>
Water quality and aquatic habitats	Forestwide	<p>1. Monitoring by the Conservation Districts has found that water quality coming off of the National Forest is good. (Sheridan County CD report on Little Goose Creek Monitoring; Earl Jensen, personal conversation).</p> <p>2. Granite Creek and the North Tongue River are presently listed on the 2004 Wyoming 305(b) Water Quality Assessment Report and 303(d) List.</p> <p>3. Tie hacking. The effects to streams were primarily from activity on Clear Creek in the 1920's and 1930's, since much of the Tongue River tie hack transport was done by tie flumes. Streams were straightened, debris removed, etc., as documented in the Clear/Crazy Landscape assessment.</p> <p>4. Influences from past high numbers of livestock grazing in riparian areas and upland sites affecting water quality and aquatic habitats.</p>
Present/Reasonably Foreseeable Actions		
Stream and watershed restoration projects:		Future projects may include active stream restoration with natural channel design or large scale watershed improvements, such as large areas of road decommissioning or stream crossing replacements.
Commodity uses	Forestwide	Ongoing timber harvest, livestock grazing, prescribed burning, recreation use, and related activities. Recreation use likely to have biggest increase on Forest of these. The anticipated future levels of these activities vary by alternative, and were used in the cumulative effects analysis. See the resource specific section that follows.
Forested vegetation treatment	Forestwide	Ongoing forested land manipulation and related activities for a variety of objectives such as: forest health, timber harvest, special use administration, fuels treatments, wildlife habitat, and hazard tree removal. Treatments associated with timber harvest and fuels are likely to be the largest share of these on the Forest. The anticipated future levels of these activities vary by alternative, and were used in the cumulative effects analysis. Among the recent timber sale decisions yet to be implemented are: Woodrock, Bench, and Bald Mountain Salvage. Existing contracts with harvest remaining include Cold Springs and Swamp. For a complete list of project effects estimated for these projects, see Bighorn website, projects and plans, at www.fs.fed.us/r2/bighorn .

Project/Action	Location	Description
Coalbed methane drilling	Powder River Basin – Sheridan, Johnson, Campbell and Converse counties	<p>The Bureau of Land Management's Record of Decision and Final Environmental Impact Statement are available at the Buffalo Field Office, Buffalo, WY, or at http://www.wy.blm.gov/nepa/prb-feis/. The decision is expected to result in, among other things:</p> <ul style="list-style-type: none"> About 39,400 new natural gas wells About 17,754 miles of new road Long-term surface disturbance to about 102,650 acres No impact upon boreal toad Effects upon the bald eagle and Ute-ladies tresses are expected to adversely affect individuals, but are not likely to jeopardize the continued existence of these species At peak construction period (2007) approximately 5,761 workers would be required.
Urbanization	Sheridan and Johnson Counties	<p>The Center of the American West at the University of Colorado projected areas of urban sprawl anticipated by 2050. (http://www.centerwest.org/futures/) A copy of that map is included in the social specialist report in the project record. It shows that the area south of Sheridan to Big Horn and Story is expected to become increasingly subdivided in the future. Some potential effects associated with the projected increase in population and the associated 'urban sprawl' are:</p> <ul style="list-style-type: none"> A loss of 'open space', an amenity prized by area residents and a contributor to the quality of life enjoyed locally. An increase in land values making traditional land uses such as ranching increasingly marginal economically An increase in the number of conservation easements developed by groups such as The Nature Conservancy. A reduction in the amount of habitat available for wildlife. This will favor species such as coyotes, skunks, and white-tail deer that have become acclimated to human environments. Increased amount of wildland/urban interface. This will affect fire suppression and increase the difficulty of pre-suppression, fuels, treatments. Heritage resource sites on private lands can be destroyed. <p>This phenomenon is not likely to occur on the west side counties because of the large amount of public land.</p>

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Project/Action	Location	Description
Subdivisions near Forest boundary	Dayton, Hazelton, Onion Gulch	Existing and new subdivisions are resulting in homes near the Forest boundary. This has recreation, access, and wildland/urban interface effects to the National Forest System lands, including changing the distribution and patterns of use. The number of subdivisions near the forest boundary is expected to increase in the future.
Highway construction/reconstruction	Bighorn NF	Reconstruction of a 2+ mile section of U.S. 16 west of Buffalo was completed in 2005. The Wyoming Department of Transportation has 12 projects on their out year planning spreadsheet. Included is the Steamboat Rock reconstruction project, which is scheduled for NEPA in 2006. A 2+ mile of US 16 is scheduled for reconstruction in 2005, starting near Deerhaven Lodge and running west to the Tensleep Creek crossing. The other projects include fence reconstruction, slide repairs, parking lot addition, snowfence south of Burgess Junction. The current WYDOT planned activity summary project listing is available in the project record.
Changing demographics (aging population)	4-county area (as well as national phenomenon)	Particularly relevant to recreation. Use by the elderly is likely to increase proportionately faster than other demographic groups given the national aging phenomenon. As tourism grows and the state and national population ages, there is also likely to be an associated added demand for increased recreation opportunities on the developed end of the Recreation Opportunity Spectrum (easier access, more amenities, etc). Demand could increase markedly for such features as interpretive sites and campgrounds of a higher development scale. Acceptable amounts of roaded access for hunting another potential "demand factor."
Yellowstone snowmobile decision	Yellowstone National Park	<p>On November 4, 2004, the National Park Service approved a Finding of No Significant Impact (FONSI) for the Temporary Winter Use Plans and Environmental Assessment for Winter Use in Yellowstone and Grand Teton National Parks and the John D. Rockefeller, Jr., Memorial Parkway. The Final Rule implementing this decision was published in the Federal Register on November 10, 2004.</p> <p>This decision allows 720 snowmobiles per day in Yellowstone, all commercially guided. In Grand Teton National Park and the John D. Rockefeller, Jr., Memorial Parkway, 140 snowmobiles would be allowed. With minor exceptions, all snowmobiles would be required to meet NPS best available technology (BAT) requirements. The plan will be in effect for three winters, allowing snowmobile and snowcoach use through the winter of 2006-2007.</p> <p>The temporary winter use management plan ensures that resources are protected, gives visitors, employees and residents of the park's gateway communities the information they want and need to plan for the near term, and will help minimize economic impacts on gateway communities.</p>

Project/Action	Location	Description
		<p>Preparation of this plan will also allow the NPS to complete a long-term analysis of the environmental impacts of winter use in the parks. The NPS expects that this long-term analysis will culminate with a permanent decision about winter use in the parks.</p> <p>Yellowstone National Park is a premier winter recreation destination. While any change in the Park's snowmobiling opportunities could potentially affect winter recreation on the Bighorn NF, it is not likely to be dramatic because Yellowstone National Park and the Bighorn National Forest offer different settings. The Bighorn National Forest is attractive because of its wide expanses of open powder; Yellowstone National Park offers a trail-based setting. Even so, there may be a slight increase due to displaced users. Further information is available at: http://www.nps.gov/yell/planvisit/winteruse/index.htm</p>
State OHV program	Bighorn NF	<p>As of January 1, 2002, all unlicensed OHVs (ATVs, dirt bikes, etc) are required to display a Wyoming OHV permit while operating on public lands including designated system roads on the Bighorn National Forest. Just as snowmobile use has increased dramatically in the 1990s, OHV use will likely continue to increase.</p> <p>Potentially positive effects that could be anticipated include additional funds from the state of Wyoming to benefit the trail system on the Bighorn National Forest in the form of signage, enhanced education and enforcement initiatives, and trail construction, reconstruction, or other trail-related improvements. For example, during the current fiscal year (2005) the State of Wyoming is providing funding to the Forest for OHV patrols which will provide education and enforcement services in support of the Forest's travel management program.</p> <p>Potential adverse effects that could be anticipated as a result of greater information/promotion include crowding from additional users at trailhead facilities as well as a higher number of encounters on open roads and trails among users.</p>

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Project/Action	Location	Description
BLM activities – Buffalo Field Office	Powder River Basin BLM lands	<p>The Buffalo Field Office Resource Management Plan (RMP) was updated in 2001, and is available on the web at: http://www.wy.blm.gov/bfo/bfoplan.htm. Excerpts are found in the Revision project record. Among the decisions that could result in cumulative effects for the Bighorn Revision are:</p> <p>Up to 10 MMBF of timber could be harvested over the 10 year plan period. 9 MMBF could be sawtimber, and 1 MMBF could be Products Other Than Logs. However, they estimated that only .130 MMBF would be harvested annually over the plan period.</p> <p>About 73,000 acres of land in northern Sheridan County is available for coal leasing.</p> <p>They estimated an annual livestock grazing output of about 110,000 AUMs.</p> <p>Out of 798,848 acres of BLM administered lands in Sheridan, Johnson, and Campbell counties, about 20,400 acres is open to vehicles off-roads if the vehicle is operated responsibly in a manner unlikely to cause significant undue damage. About 37,600 acres are closed to all motorized vehicles year round, and motorized travel is restricted to roads and routes on about 737,000 acres.</p> <p>Middle Fork of Powder River will be managed as a Wild/Scenic River.</p>
BLM activities – Worland Field Office – Washakie Resource Management Area	Primarily east half of BLM lands in the Bighorn River Basin	<p>The Worland Field Office Washakie Resource Management Plan (RMP) was completed in September 1988, with minor updates in 1997 and 1999. It is available on the web at: http://www.wy.blm.gov/wfo/plan/washrmp.htm. Excerpts are found in the Revision project record. Among the decisions that could result in cumulative effects for the Bighorn Revision are:</p> <p>Harvest levels were not set, but "...will be based on treatments needed to meet management objectives."</p> <p>They estimated an annual livestock grazing output of about 142,000 AUMs.</p> <p>Out of 1.23 million acres of BLM administered lands in Washakie, Big Horn and Hot Springs counties, about 6700 acres are closed to all motorized vehicles year round, and motorized travel is restricted to roads and routes on about 1.22 million acres.</p> <p>Opportunities for recreational access would be emphasized in Laddie Creek, Paint Rock Creek and Upper Nowood River.</p>

Project/Action	Location	Description
		Spanish Point Karst, Big Cedar Ridge Fossil Plant, Red Gulch Dinosaur Track, and upper Owl Creek areas are managed as Areas of Critical Environmental Concern (approximately like an RNA on National Forest System Lands).
Bureau of Indian Affairs – Final EIS – Wind River Gas Field Development Project	Wind River Agency near Fort Washakie, Wyoming	<p>This EIS was issued on 12/1/04. The proposed action is for natural gas development of 325 new wells drilled at 325 separate locations, plus construction of needed infrastructure to connect to existing transmission systems, over a 20 year time frame. This project is upwind of the Bighorn NF, and the EIS projected effects to the Cloud Peak airshed. The complete EIS is available at the Bighorn NF supervisor's office. The executive summary includes the following cumulative effects summary:</p> <p>"Minor long-term nitrogen deposition impacts are predicted to occur at Cloud Peak Wilderness as a result of cumulative sources. The Wind River Project would not substantially contribute to the Cloud Peak deposition impacts. Nitrogen deposition impacts are predicted to be negligible for the remaining areas of special concern. As a result of cumulative sources impacts are predicted to occur at two lakes located in Cloud Peak Wilderness. Moderate long-term impacts are predicted to occur at Florence Lake, where changes in acid neutralization capacity (ANC) are predicted to exceed the level of acceptable change. Minor long-term impacts are predicted to occur at Emerald Lake where changes in ANC levels would be detectable. The contribution of Project sources upon these cumulative impacts would be negligible. Impacts to ANC at the remaining lakes of special concern would be negligible.</p> <p>Cumulative and Project sources would contribute to regional visibility impacts. Moderate long term visibility impacts are predicted to occur at Cloud Peak Wilderness as a result of cumulative sources. However, the contribution from Project sources to the Cloud Peak impacts would be negligible."</p>
BLM Activities – Cody Field Office Trail relocation and trailhead construction	Lands west of Bighorn National Forest border.	The BLM is implementing two trail maintenance and one trailhead construction projects on the west face of the Bighorns on BLM-managed land abutting up to the National Forest. They will involve the Cottonwood Creek trail and Pete's Canyon trail. A trailhead with camping sites will be built at the mouth of Cottonwood Canyon. The trails will remain nonmotorized use. Possible effects include improved ease of public access to the northwest portion of the Bighorn National Forest as well as the need for placement of gates or cattle guards at the National Forest boundary fence. This is projected to occur irregardless of alternative.

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Project/Action	Location	Description
BLM Wind Energy Development Programmatic EIS	BLM lands throughout the western US, including Wyoming	In June, 2005, the BLM published the Final Programmatic EIS (PEIS) on Wind Energy Development on BLM-Administered Lands in the Western US. This PEIS includes proposed amendments to all of the resource management plans in Wyoming, including Buffalo Resource Management Plan (RMP), Cody RMP, and Grass Creek RMP. The proposed action, which would implement a Wind Energy Development Program, establishes policies and best management practices for wind energy right-of-way authorizations. The PEIS and RMP amendments can be found at http://windeis.anl.gov
State of Wyoming – Timber harvest	State land in Johnson, Sheridan and Campbell counties	<p>Average of 700,000 MBF annually. Likely to continue at that level for foreseeable future. Silvicultural systems used, primarily, are:</p> <p>Even aged, clearcut: lodgepole pine.</p> <p>Even aged, shelterwood: ponderosa pine.</p> <p>Even aged, shelterwood or uneven-aged, selection: Douglas-fir (manage per existing age structure).</p> <p>Uneven aged, selection: spruce-fir.</p> <p><i>(from Bill Haagenson, State Forestry, 3/04)</i></p>
State of Wyoming – Timber harvest	State and private land in Bighorn, Washakie, Park and Freemont counties	<p>A conservative estimate is about 500 MBF/year for the next few years.</p> <p><i>(from Paul Morency, State Forestry, 3/04)</i></p>
Timber harvest	Crow Reservation	Estimate about 2.5 MMBF per year in the foreseeable future.
Timber harvest	Northern Cheyenne Reservation	A number of larger fire salvage sales in the recent past. Estimate about 6 MMBF per year in the foreseeable future.
Timber harvest	Shoshone National Forest	A number of larger bug killed salvage sales in the recent past. Estimate about 6 MMBF in various products per year in the foreseeable future. They have just started the plan revision process.
Timber harvest	Private lands	There are no records of all the private timber sales, so it is unknown how much timber harvest there will be in the foreseeable future. The timber supply/demand study, as updated for the FEIS, indicates that multiple sources have indicated that the current harvest level is unsustainable, but is expected to decline. None of the sources could quantify the future expected outputs.

Project/Action	Location	Description
Regional haze reduction program	Wyoming, Utah, Arizona, New Mexico, Oregon	In January 2004, five states announced a plan to cap sulfur dioxide emissions from major industrial sources such as coal fired power plants, smelters, and refineries. Currently, sulfur dioxide emissions in the five states total about 360,000 tons per year. The cap would allow 309,000 tons to be emitted annually by 2018. The reduction effort stems from 1977 and 1990 amendments to the Clean Air Act that required cutting back on pollutants that impair visibility in Class I airsheds. Non-class I airsheds are expected to benefit. Montana and other states in the region are expected to produce their own plans by the end of 2007.
Fuel treatment	Bighorn NF and adjacent land ownerships, including Bureau of Land Management, Bureau of Indian Affairs, National Park Service, Wyoming state lands, and private lands.	Large catastrophic fires occurring during recent drought years have stressed the need to treat wildland fuels to re-introduce fire into fire adapted ecosystems, to increase public and firefighter safety, and to reduce the potential for resource and property loss from wildland fires. The National Fire Plan and various legislations have encouraged treatment of wildland fuels. Recent legislation, such as the Healthy Forests Initiative and the Healthy Forests Restoration Act continue to increase this emphasis. Based on need and current emphasis, both mechanical fuel treatments and prescribed fire activities are expected to increase on all ownerships although to a higher degree on federal managed lands during this planning period.
Woodrock Project	SE of Burgess Junction	Recently signed Record of Decision that includes: Change summer motorized travel from off-road allowed to designated routes only. Close campsites where impacts to riparian/ watershed cannot be mitigated. 1800 acres of timber harvest or thinning. Up to 2 miles of temporary road construction, to be obliterated after use. No permanent road construction. Complete ROD/FEIS at: http://www.fs.fed.us/r2/bighorn/projects/projectfiles/woodrock
Bench Project	Shell Canyon	Recently signed Decision Notice that includes: Vegetation treatment on about 1,162 acres. Salvage logging, thinning, fuel break construction, and burning. Six miles of temporary road construction, to be obliterated after use. No permanent road construction. Complete ROD/FEIS at: http://www.fs.fed.us/r2/bighorn/projects/projectfiles/bench/bench_webpage.pdf

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Project/Action	Location	Description
Clear/Crazy Travel Mgt.	Clear Creek and Crazy Woman Creek watersheds on Bighorn NF	<p>Recently signed Decision Notice that includes:</p> <p>Change summer motorized travel from off-road allowed to designated routes only.</p> <p>About 14 miles of ORV trails to be added to system, most already exist.</p> <p>Decommission about 8 miles of system road, primarily in riparian areas.</p> <p>10 miles of motorized routes changed to nonmotorized.</p> <p>Complete DN/FONSI and EA at: http://www.fs.fed.us/r2/bighorn/projects/projectfiles/</p>
Scheduled Bighorn NF planning Activities - SOPA	Forestwide	<p>This schedule is updated on a quarterly basis, and can be found at: http://www.fs.fed.us/r2/bighorn/projects/sopa/</p> <p>This document summarizes the reasonably foreseeable activities that are in some stage of planning at the present time.</p>
Scheduled Custer NF planning Activities - SOPA	Forestwide	<p>This schedule is updated on a quarterly basis, and can be found at: http://www.fs.fed.us/r1/custer/projects/index.shtml</p> <p>This document summarizes the reasonably foreseeable activities that are in some stage of planning at the present time.</p>

The cumulative effects discussed in the previous table are negligible and do not vary by alternative. To ensure long-term productivity of the land, the environmental consequences of alternatives are limited by management requirements. Many are founded in law, federal regulations, and Forest Service policy. Environmental consequences are also limited by forestwide standards and guidelines. The alternatives considered in detail, and their forestwide and management area standards and guidelines, were designed to prevent extreme environmental consequences.

The resources on the Bighorn National Forest are affected by both on-Forest and outside influences, including loss of open space, increasing recreation demands, energy exploration and development, forested vegetation management, and road construction.

- ◆ Subdivision of the undeveloped, natural landscape – The loss of open space is one of the Chief’s four threats. The social section describes the risk to subdivision, and it is particularly high for Johnson and Sheridan counties, with large effects to wildlife habitat, water quality, and scenery.
- ◆ Increased recreation use by a growing population – The population of north central Wyoming is increasing, and people like to recreate on the Bighorn NF. Even though the Forest has many ‘safeguards’ in place (standards, guidelines and special orders), people still affect the environment when they recreate.

- ◆ Oil, gas, and coal development – This is the largest single environmental impact occurring in north central Wyoming. It is a large contributor to the increasing population and subdivision threats. There are also effects on air quality and water resources.
- ◆ Timber sales – Timber sales on National Forest lands are, by law, sustainable and are planned in a multiple use context. They are not land conversions to other uses such as subdivision and agriculture, but are temporary successional stage changes that mimic, broadly, natural successional processes. The variance in the amount of timber harvest by alternative, compared to the activities affecting the environment in the 4-county area is negligible.
- ◆ Roads – The Revised Plan is projecting no more than 2.1 miles of system road construction, plus 4 miles of system and non-system road decommissioning. This is in comparison to the 17,000+ miles of road anticipated in the Powder River Basin Coalbed Methane EIS.
- ◆ Unconfined recreation – The revised plan restricts summer motorized use to open, designated routes, and prioritizes campsite water quality improvements in the highest value watersheds. The Revised Plan provides tools to manage and accommodate the increasing recreation use demand expected.

Under any alternative considered, the Bighorn National Forest will continue to be an island of less developed, high environmental quality land amidst an increasingly developed and populated region. The effects upon the environment of the actions projected by the implementation of the Revised Plan are negligible, under all alternatives, when added to the effects occurring in the surrounding landscapes.

Relationship Between Programmatic and Site-Specific Effects Analysis

This FEIS is a programmatic document. It discloses the assumed environmental consequences on a Forestwide scale of 1.1 million acres. This is in contrast to analyses for site-specific projects. The FEIS represents a programmatic action at a Forest level of analysis but does not predict what will happen each time the standards and guidelines are implemented. Environmental consequences for individual, site-specific projects on the Forest are not described. The environmental effects of individual projects will depend on the implementation of each project, the environmental conditions at each project location, and the application of the standards and guidelines in each case.

The affected environment and environmental consequences discussions in Chapter 3 allow a reasonable prediction of consequences for any individual location on the Forest. However, this document does not describe every environmental process or condition.

The interdisciplinary team based FEIS environmental consequences on past experience, monitoring, reviews by internal and external peers, and projected alternative outputs. The effects displayed in the FEIS use the best available science, but must be recognized as

projections at a very coarse scale. Even if the absolute value of projected effects are high or low, the relative value between alternatives should be accurate because consistent, scientifically based, analysis techniques were utilized, allowing for a reasoned and rationale choice between alternatives.

Budget Levels

A forest plan provides broad direction but does not authorize specific actions. Authorization of specific actions is made through site-specific project analyses. As a result, the FEIS is an estimate of effects that may or may not occur. One of the primary reasons for this uncertainty is future budget levels. Outputs and effects estimated in the FEIS are assumed to be achievable under current and anticipated future budget levels. The future budget level estimate used for this FEIS is the current budget adjusted for inflation. Timber program outputs are displayed in terms of Allowable Sale Quantity (ASQ), which is not budget constrained and also in terms of Total Sale Program Quantity (TSPQ), which is budget constrained.

Implementation of the 1985 Plan showed that plan outcomes and desires do not affect budget levels; whereas national initiatives, such as the National Fire Plan, have a much greater impact on the Forest budget. Since future national initiatives are unpredictable, we are estimating future outputs and effects were estimated assuming current budget levels.

Incomplete and Unavailable Information

The Council on Environmental Quality established implementing regulations for the National Environmental Policy Act (NEPA, 1969). These provisions under 40 CFR 1505.22 require the identification of relevant information that may be incomplete or unavailable for an evaluation of reasonable foreseeable significant adverse effects. If information is essential to a reasoned choice among alternatives, it must be included or addressed in an EIS.

The alternatives and their effects were evaluated using the best available scientific information. New information, further consultation with the scientific community, and more accurate data collected since the publication of the Draft EIS helped modify and refine the Final EIS. The public review and subsequent comment period provided new information and insights that were used to help improve the estimated effects shown in the FEIS. Though new information is always welcome, and better information will be incorporated into project level implementation, none of the incomplete or unavailable information was essential to a reasoned choice among the alternatives. Additional information, data collection, and interpretation can refine our understanding of the ecological, social, and economic relationships on the Forest; however, new information is unlikely to significantly change our basic understanding of the relationships and concepts that are the basis of our effects evaluation. As the plan is implemented, monitoring and evaluation will also help bridge gaps in our knowledge base and improve management of the Forest. Monitoring and evaluation let us assess the effectiveness and validity of forest plan direction and assumptions and modify our management approach accordingly.

Knowledge and information are always incomplete, particularly with infinitely complex ecosystems considered at various scales. Jack Ward Thomas, former Chief of the Forest Service, commented that ecosystem management is not only bigger than we think but “bigger than we *can* think.” Ecology and management of complex systems are still developing disciplines; however, fundamental ecological relationships and interactions are well established in existing science. Using existing science, available data and information, and monitoring, evaluation, and adaptive management, forest plan implementation can proceed despite incomplete or unavailable information.

Physical Elements

Air Quality

Introduction

Air pollution has the potential to impact a variety of resources on the Bighorn National Forest including visibility, water, soils, and sensitive species of flora and fauna. The Forest Service is involved in the protection of air quality through a number of laws and regulations. Air quality on the Forest is good and typically meets national and state air quality standards, except in the case of large wildfires, where air quality standards may be temporarily and locally exceeded. The only designated Wilderness within the Bighorn National Forest is Cloud Peak, a Class II air quality area. No portion of the Forest is currently in a non-attainment area; however, the Sheridan, Wyoming area has been designated as a federal non-attainment area (PM₁₀ – moderate), where applicable standards have been violated in the past.

Management actions on the Forest have not caused clean air standards to be exceeded, except in extreme cases of wildland fire. Forest management activities and other uses have the greatest potential to directly affect particulate levels through the amount of dust generated from road use and construction, and smoke produced from wildland and prescribed fires. Localized impacts from prescribed fire use are typically short-term and will be mitigated accordingly in coordination with the Wyoming Department of Environmental Quality/Air Quality Division (WYDEQ/AQD), in order to ensure that air quality standards are not exceeded. By applying state, federal, and local regulations, the Forest will be able to protect the local environment of the Bighorn National Forest from unacceptable air pollution impacts.

Legal and Administrative Framework

The Federal Clean Air Act, amended 1977 and 1990 – this act designates wilderness over 5,000 acres and in existence as of August 7, 1977 (including later expansions) as Class I areas. Section 169(A) of the act requires “the prevention of any future and the remedying of any existing impairment of visibility in mandatory Class I areas ...” Within Class I areas, the act protects air-quality-related values (AQRVs) from adverse impacts due to air pollution. AQRVs are features or properties that can be changed by human-caused air pollution: plants; animals; water; visibility; odor; and cultural, archaeological, and paleontological resources. Under the Clean Air Act, the Forest Service is required to comply with all federal, state, and local air quality regulations and to ensure that all management actions conform to the State

Implementation Plan (SIP). To comply with recently developed regulations under the Clean Air Act, the Forest Service must evaluate all management activities to ensure they will not:

- ◆ Cause or contribute to any violations of ambient air quality standards.
- ◆ Increase the frequency of existing violations.
- ◆ Impede a state's progress in meeting their air quality goals.

The Clean Air Act, Section 169 (A), required the federal Environmental Protection Agency (EPA) to produce regulations to ensure reasonable progress toward meeting the national visibility goal for Class I areas where EPA determined that visibility was an important value. Section 109 gave the EPA the authority to establish national ambient air quality standards. The Wyoming Department of Environmental Quality is the state regulatory agency responsible for air quality and is primarily responsible for enforcing EPA's air quality standards

The Wilderness Act of 1964 – this act, and the Code of Federal Regulations (CFR) developed to implement it, give the Forest Service the responsibility and direction to manage designated wilderness areas to preserve, protect, and restore, as necessary, natural wilderness condition.

The EPA's Interim Air Quality Policy on Wildland and Prescribed Fires provides guidance on mitigating air pollution impacts caused by wildland and prescribed fires while recognizing the current role of fire in wildland management.

The Wyoming Air Quality Standards and Regulations (WAQS&R) – Standards and regulations are promulgated by the Wyoming Environmental Quality Council, in accordance with the Environmental Quality Act. These standards and regulations are occasionally revised by the Wyoming Department of Environmental Quality, Air Quality Division, to implement mandated federal environmental programs in a manner that best meets the needs of the state of Wyoming. Wyoming recently adopted new smoke management regulations (in Chapter 10 of the WAQS&R) which have a large affect on Forest management activities.

Resource Protection Measures

The Forest Service is responsible for protecting the Cloud Peak Class II area AQRVs from adverse effects due to air pollution. This responsibility is carried out through the Prevention of Significant Deterioration (PSD) permit process and includes:

- ◆ Identifying sensitive receptors, if any, for each AQRV.
- ◆ Determining the potential effects, if any, on sensitive receptors from a potential new air pollution source.
- ◆ Determining if a potential effect is adverse.

The Forest Service will review and comment on any PSD applications for sources that may have a potential impact on Forest Service lands following the Federal Land Managers Air Quality Related Values (FLAG) policy and other applicable agency policies. The Forest Service will conduct monitoring for AQRVs and to comply with federal Clean Air Act regulations, the Forest Service will evaluate activities on National Forest System land that might impact an airshed and will mitigate emissions where necessary.

Smoke from prescribed fires will be managed by burning on days when air quality degradation can be minimized. How well the smoke will disperse is a key consideration in prescribed burning decisions. Coordination with the WYDEQ/AQD will help to ensure that prescribed fires do not violate the applicable standards for particulate matter.

On Forest Service projects, road dust will be evaluated if there is an air quality concern. Mitigation measures could include a change in the type of road surface, season of use, daily time/use restrictions, road closures, use of dust abatement products or practices such as road watering, and management for lower speeds on gravel and native surfaced roads.

AFFECTED ENVIRONMENT

Regional

A review of the 1996 actual emissions from counties within 100 km of the Bighorn National Forest showed the following contributors of air pollutants: sulphur dioxide, nitrous oxide, and volatile organic compounds. The largest contribution of SO₂ emissions is from oil and gas production/distribution, followed in order of contribution by electric services, petroleum refining, and chemical production. The largest source of NO_x emissions is from oil and gas production/distribution, followed by electric services. The largest contribution of volatile organic compound emissions is from oil and gas production/distribution, followed by petroleum refining, then electrical services and the greatest contribution of particulate matter is from coal and lignite mining.

Other than statewide information, there are no data on emission or source category trends near the Bighorn National Forest. However, air quality near the Forest is being measured as part of an analysis of potential impacts from oil and gas development in the surrounding region.

Forestwide

Air quality conditions in rural areas surrounding the forest are generally very good, as indicated by limited air pollution emission sources (few industrial facilities and residential emissions in relatively small communities and isolated ranches) and good atmospheric dispersion conditions, resulting in relatively low air pollutant concentrations. Occasional high concentrations of CO and particulate matter may occur in more urbanized areas with automobiles and home fireplaces (for example Buffalo and Sheridan) and around industrial facilities, especially in the stable atmospheric conditions common during winter.

Emissions from fire, including prescribed fire, wildfire, and recreational campfires, are a contributor to air pollution on the Forest during the spring, summer, and fall. During periods of drought and/or wind events, fires have historically grown quite large and can affect local air quality for several weeks. Slash disposal from timber harvest activities has generally been done

by pushing the logging residue into piles and burning them when the fire hazard on the Forest is low.

Approximately 2,500 acres on the Forest are burned annually, using prescribed fires. This is a relatively small prescribed fire program compared to other western Forests. Prescribed fires are an intermittent source of particulates that can cause short-term visibility problems and temporary changes in ambient air quality. Annual smoke permits are obtained from the WYDEQ/AQD, based on estimated emissions from prescribed burn plans. The Division is notified prior to, and must give approval for, any prescribed burning activities that are conducted.

Road dust from vehicle traffic on the 1,445 miles of unpaved Forest roads (Maintenance levels 1-3) also adds particulates to the air. In general, these emissions have only caused air quality concerns in localized areas. During dry periods of the year, traffic on some roads can generate localized road dust, which is generally viewed as a traffic hazard and a social issue.

The only wilderness in the Bighorn National Forest is Cloud Peak, a Class II air quality area. The Forest developed an air quality monitoring plan for the Wilderness in 1992. The plan includes monitoring objectives, resource susceptibility and current status, monitoring protocols, and a section on how to use the monitoring data. The Forest is currently monitoring lake water chemistry and visibility. The WYDEQ/AQD operates a visibility monitoring station located about 14 miles west of Buffalo, Wyoming. These monitoring programs provide the necessary data used in local, regional, and state-wide air quality assessments and are crucial to understanding current conditions, trends, and potential impacts of proposed development on air quality and air quality related values.

Visibility and lake chemistry data have been collected on the Forest, and ozone and deposition data have been collected at nearby sites. The following table lists the air quality data that have been collected on the Forest.

Table 3-2. Air quality monitoring on the Bighorn National Forest.

Data Source	Parameter	Dates
Forest Service	Lake chemistry (long-term)	1994-Present
Forest Service	Lake chemistry	1992-1993
Forest Service	Visibility (camera only)	1995-2001
State of Wyoming	Visibility monitoring	2001-Present

Photographic data have been collected on the Forest since 1995. Photographs were evaluated from data collected in the summer, to provide a rough estimate of the standard visual range (SVR). SVR is inversely related to light extinction and can be interpreted as the farthest distance a large, black feature can be seen under prevalent atmospheric conditions. The theoretical maximum SVR is 391 km. Photographs suggest that the best visibility obtainable in the Bighorn National Forest, is 327 km, making visibility some of the best in the lower 48 states.

The Wyoming Game and Fish Department conducted periodic lake chemistry sampling in and near the Forest between 1984 and 1991. The Forest conducted synoptic sampling of 35 lakes in the Cloud Peak Wilderness in 1992 and 1993. These surveys identified a number of lakes in the wilderness with acid neutralizing capacity (ANC) below 100 micro equivalents per liter ($\mu\text{eq/l}$), indicating that lakes on the Forest are sensitive to acid deposition. In fact, many of the lakes are extremely sensitive, with an ANC below 25 $\mu\text{eq/l}$. The Cloud Peak Wilderness had a higher percentage of sampled lakes with acid sensitivity than the Collegiate Peaks, Eagles Nest, Mount Evans, Weminuche, or San Juan Wilderness Areas in Colorado.

Two lakes in the wilderness, Emerald and Florence, have been selected for long-term monitoring. While monitoring has not been conducted long enough to detect trends in air quality, data collected from 1994 through 1997 have consistently shown that these two lakes are acid-sensitive, having a low buffering capacity. Data have not been collected for other air quality related values,¹ except that a list of plant species with known sensitivity to air pollution has been developed for the Cloud Peak Wilderness (USDA 1992).

Particulate matter pollution consists of very small liquid and solid particles floating in the air. Particles small enough to be inhaled into the deepest parts of the lung pose the greatest public health hazard. These particles are less than 10 microns in diameter and are known as PM_{10} . The City of Sheridan is in non-attainment for the PM_{10} standard under the National Ambient Air Quality Standards (NAAQS). Under the ‘conformity’ section of the Clean Air Act, federal agencies such as the USDA Forest Service are prohibited from conducting or approving activities that could impede the clean-up of these areas. Consequently, Forest Service activities, such as prescribed fire, that produce pollutants in or near Sheridan may be subject to special restrictions, documentation requirements, and or mitigation.

Ozone data have not been collected on the Bighorn National Forest. However, Yellowstone National Park data are likely to be representative of conditions on the Forest. The Yellowstone National Park values for these statistics are far below those believed to result in foliar injury or growth effects in vegetation. In conclusion, ozone concentrations at Yellowstone, and probably at the Bighorn National Forest, are not currently high enough to affect human health or vegetation. It is not likely that ozone concentrations will increase significantly in the future (USDA, 1999).

ENVIRONMENTAL CONSEQUENCES

General Effects

Management activities are not expected to change existing air quality, or violate air quality standards and visibility goals on the Bighorn National Forest under Alternative D-FEIS.

¹ Air quality related values (AQRVs) include flora, fauna, soil, water, cultural resources, odor, and visibility.

Temporary reductions in visibility and increases of fine particulate matter may occur downwind from sizeable wildland or prescribed fires. Long-term air quality impacts to the Forest would likely come from upwind regional sources, such as fossil-fuel burning power plants, oil and gas extraction activities, large wildland fires occurring locally or regionally, and adjacent urban areas, such as Sheridan and Buffalo.

Direct and Indirect Effects

Forest management activities that can directly affect air resources include prescribed fires, use of vehicles, developed recreation, mining, and oil and gas development. Indirect impacts to air quality can result from site specific management decisions: for example, issuance of a special use permit to expand a ski resort, resulting in increased vehicle emissions from additional people driving to the ski area to work or recreate.

Effects from Travel Management: Air quality impacts from Forest roads and trails are associated with vehicle emissions and dust from traffic on unpaved roads. These effects typically are localized and temporary, and their extent depends on the amount of traffic and road condition. Dust production from unpaved roads increases with dryness as well as vehicle weight and speed.

Roads and trails on the Forest are typically unpaved, used for both recreational purposes, such as off-highway vehicle (OHV) and four-wheel-drive full size vehicle and resource management activities, such as timber harvesting, grazing, mining, or administrative purposes. All alternatives being considered, including Alternative D-FEIS, propose to decommission or close approximately four miles of system or non-system roads annually. The six alternatives also allow for the reconstruction of existing roads and some limited new road construction which consequently has the potential to affect short term air quality in localized areas.

Effects from Recreation: Motorized recreation occurs year-round. Summer use includes off-highway, two-wheel, and four-wheel drive vehicles. Travel on unpaved surfaces by these vehicles can stir up dust. To date, these localized impacts have not been known to adversely affect air quality in sensitive areas, such as important scenic vistas, campgrounds, visitor centers, or other heavily used areas. An increase in overall visitor use is expected under all alternatives, resulting in an increased use of Forest system roads. As a consequence, impacts from particulates produced from the increased use of unpaved roads may need to be addressed.

Winter motorized recreation is predominantly limited to snowmobiles. Emissions from these vehicles include carbon monoxide, oxides of nitrogen, and particulate matter. Most of the effects of winter motorized recreation are localized and temporary. Conflicts arise when this recreation use occurs alongside areas with nonmotorized recreation pursuits, where clean air is desirable. With changes in allocations to Management Areas, snowmobile use is expected to be displaced elsewhere on the Forest rather than affecting a decrease in the amount of overall use. The number of snowmobiles on the Forest is also expected to increase, regardless of actions proposed under any of the alternatives. As a consequence of the increased use of snowmobiles, impacts from particulates produced from the increased winter motorized use may need to be addressed in the future.

Effects from Fire and Fuels Management: Both wildfires and prescribed fires generate smoke and particulates that can temporarily degrade visibility and ambient air quality conditions in downwind sensitive areas. Those alternatives with the most fuel treatment acres proposed are Alternatives B and D-FEIS, while Alternative C proposes the least (see the Fire and Fuels section of this chapter). Alternatives with more management area allocations that emphasize natural processes, such as Alternative C, have the highest potential for, and the most acreage potentially impacted by wildfire.

The Wyoming Department of Environmental Quality/Air Quality Division (WYDEQ/AQD) requires the Forest to model the emissions from each prescribed burn or management-ignited fire and demonstrate that they will not violate ambient particulate standards. Computer modeling is used to evaluate particulate matter (PM) emissions less than 10 and 2.5 microns in size (PM10 and PM2.5) from fire and their effects on air quality. The Simple Approach Smoke Estimation Model (SASEM) is currently the required model; the results are submitted to the WYDEQ/AQD before a burn permit is issued. SASEM can estimate the number of acres that could be burned at one time without exceeding the NAAQS. The Forest Service must conduct its management-ignited fires according to the conditions outlined in burn plans submitted and approved by the WYDEQ/AQD. In addition, the Forest Service must coordinate its planned burns with local health agencies. Prescribed burns that have the potential for significant smoke impacts must have a plan that addresses nighttime smoke impacts. Also required is coordination with the National Weather Service to mitigate these impacts. Although management-ignited fires may increase emissions in the short term, these burns could help to decrease the emissions from catastrophic wildfires by reducing the fuel loading over the long term.

Effects from Oil and Gas Development: Air quality is affected by oil and gas development activities that include road and drill pad construction, development-related vehicle traffic, well drilling, well testing, and gas compression. Air pollutants of concern include particulate matter from dust during well site construction and from vehicle traffic on unpaved roads, carbon monoxide and nitrogen oxides from gasoline and diesel engines (e.g., vehicles and stationary engines such as generators), and hydrocarbons released during natural gas extraction. Emissions from pipeline compressor engines include nitrogen oxides, carbon monoxide, formaldehyde, and volatile organic compounds (VOCs). Emissions from glycol dehydrators include nitrogen oxides, carbon monoxide, VOCs, and hazardous air pollutants (HAPs). However, because most of the Forest has limited potential for oil and gas resources, with only one exploratory well drilled approximately thirty years ago, it is estimated that there will be no oil and gas development on the Forest during this planning period.

Cumulative Effects

Impacts to air quality can come from both on-Forest and off-Forest activities and are considered here as occurring over the life of the Revised Plan. The scale for considering cumulative effects includes upwind sources of particulates and may be several hundred miles wide. Most cumulative effects are expected from within Wyoming and neighboring upwind states such as Utah, Idaho, and Montana. The cumulative effects table at the

beginning of this chapter includes the list of past, present, and reasonably foreseeable future activities that were considered with regard to cumulative effects to air quality. Generally, long-term air quality impacts to the Forest will likely come from regional oil and gas extraction activities, fossil fuel burning activities at regional power plants, and from adjacent communities as populations increase. Emissions can come from both mobile and stationary sources. Mobile source contributors include vehicle exhaust, dust from construction activities, and dust from increasing road traffic. Stationary source contributors off-Forest include industrial and commercial operations and power plants upwind from the Forest.

Minor road construction would occur under any alternative. The cumulative disturbance from road construction, reconstruction, and maintenance from upwind sources varies little among alternatives. Recreation use of Forest roads under all alternatives is expected to increase in response to an increasing population. Overall, air quality impacts generated by recreational use of roads would vary little among alternatives. As growth continues, pollution generated by vehicles will increase. Forest road construction, reconstruction, maintenance, and use under all alternatives will contribute only a small amount of the road-related air pollution in the region. The cumulative road-related impacts from upwind sources vary little among the alternatives.

Very small mineral operations occur on the Forest. Where they do occur, the impacts on air quality are negligible. The cumulative impacts of these operations would not differ between alternatives. Mineral operations that could potentially affect air quality on the Forest are oil and gas development operations in the surrounding region.

Smoke from wildland and prescribed fires can adversely affect air quality. The Bureau of Land Management and the state of Wyoming manage lands in counties surrounding the Forest. Smoke from prescribed burning operations on these lands could individually, or in combination with other fires, affect air quality on the Forest and in surrounding communities. The Forest would continue to work with the WYDEQ/AQD for coordination and approval of prescribed fires to help ensure that the cumulative impact of these burns do not unacceptably impact air quality. Wildfires will continue to cause temporary deviations from air quality standards under Alternative D-FEIS.

With Alternative D-FEIS, cumulative impacts on air quality from Forest management activities would be small, and in general, temporary and localized. All areas of the Bighorn National Forest currently meet state and federal air quality standards and show no degradation to visibility or other air-quality-related values. Compliance with local, state, and federal air quality regulations will ensure that future forest management activities under any of the alternatives will continue to protect air resources on the Forest and not contribute to air quality degradation off of the Forest to downwind areas. The state of Wyoming has the regulatory authority for controlling emissions including those emissions with potential to adversely impact Forest resources.

There may be some effects to Bighorn National Forest air quality due to the Wind River Gas Field Development project on the Wind River Reservation. The effects of drilling 325 wells, and associated infrastructure development is summarized from the 12/2004 EIS:

“Minor long-term nitrogen deposition impacts are predicted to occur at Cloud Peak Wilderness as a result of cumulative sources. The Wind River Project would not substantially contribute to the Cloud Peak deposition impacts. Nitrogen deposition impacts are predicted to be negligible for the remaining areas of special concern. As a result of cumulative sources impacts are predicted to occur at two lakes located in Cloud Peak Wilderness. Moderate long-term impacts are predicted to occur at Florence Lake, where changes in acid neutralization capacity (ANC) are predicted to exceed the level of acceptable change. Minor long-term impacts are predicted to occur at Emerald Lake where changes in ANC levels would be detectable. The contribution of Project sources upon these cumulative impacts would be negligible. Impacts to ANC at the remaining lakes of special concern would be negligible.

Cumulative and Project sources would contribute to regional visibility impacts. Moderate long term visibility impacts are predicted to occur at Cloud Peak Wilderness as a result of cumulative sources. However, the contribution from Project sources to the Cloud Peak impacts would be negligible.”

Water monitoring is being conducted at Florence and Emerald Lakes to provide an early warning alert if effects do occur from the Wind River drilling operations.

One item listed in the cumulative effects summary table in the beginning of Chapter 3 is the regional haze reduction program, which will result in long-term air quality benefits.

Table 3-3. Summary of cumulative effects, by alternative, upon air resource.

Effects variable	Less Impact ← Relative Impact → More Impact to air resources					
	C	D-FEIS	B	D-DEIS	A	E
Travel Management (Miles of road construction)						
Recreation (Total number of visits)		D-FEIS, D-DEIS, B, C			A and E	
Fire and Fuels (Acres ignited by FS)	C	A	E	D-DEIS	D-FEIS	B
Oil and Gas (No O/G activity projected on Forest)	No difference between alternatives since there is no direct or indirect effects on Bighorn National Forest.					

Aquatic, Riparian, and Fisheries Resources

Introduction

There are a variety of aquatic and riparian ecosystems on the Bighorn National Forest: streams, rivers, ponds, reservoirs, wetlands, and riparian areas (Winters et al. 2004). These ecosystems support complex communities of vertebrate and invertebrate aquatic animals and an assortment of riparian and aquatic plants. Complex, species-rich communities of phytoplankton, zooplankton, macroinvertebrates, and fish can be found in many of these habitats.

Historically, people have used aquatic ecosystems for many purposes. Common uses of aquatic ecosystems include water development facilities for agricultural and municipal uses and water-dependent recreational uses. Human demand for water resources is increasing, and meeting these demands will be challenging for Forest resource managers in the future.

Forest management activities can affect the physical, chemical, and biological characteristics and functions of aquatic ecosystems. The challenge to resource managers is to implement multiple-use activities while conserving, protecting, and restoring aquatic biodiversity, watershed/stream health, and riparian/wetland conditions.

Legal and Administrative Framework

The Federal Water Pollution Control Act (Clean Water Act) was enacted to restore and maintain the chemical, biological, and physical integrity of the nation's waters. The Endangered Species Act requires federal agencies to conserve threatened and endangered species. These acts, along with other land use laws, executive orders, and policies guide management of aquatic resources on NFS lands. Other laws pertinent to watershed management of NFS lands can be found in Forest Service Manual (FSM) 2501.1.

The Organic Administration Act of 1897 recognized watersheds as systems to be managed with care to sustain their hydrologic function and secure favorable conditions of water flow.

The Federal Water Pollution Control Act, as amended, intends to restore and maintain the chemical, physical, and biological integrity of the Nation's waters. There are five required elements:

- ◆ Compliance with state and other federal pollution control rules.
- ◆ No degradation of instream water quality needed to support designated uses.
- ◆ Control of nonpoint source water pollution through conservation or Best Management Practices (BMPs).
- ◆ Federal agency leadership in controlling nonpoint sources pollution from managed lands.
- ◆ Rigorous criteria for controlling discharge of pollutants into the Nation's waters.

The Sustained Yield Forest Management Act of 1944 and the **Multiple Use Sustained Yield Act of 1960** allow for the production of multiple quality goods and resources at sustained levels over time, including maintenance of water supplies.

The Forest and Rangeland Renewable Resources Planning Act of 1974, as amended, requires an assessment of present and potential productivity of the land. This act contains many references to suitability and capability of specific land areas, to maintenance of land productivity, and the need to protect and, where appropriate, improve the quality of soil and water resources. The act specifies that substantial and permanent impairment of productivity must be avoided and has far-reaching implications for watershed management on National Forests.

The National Forest Management Act of 1976 prevents watershed condition from being irreversibly damaged and protects streams and wetlands from detrimental impacts. Land productivity must be preserved. Fish habitat must support a minimum number of reproductive individuals and be well distributed to allow interaction between populations.

The Endangered Species Act of 1973 requires federal agencies to conserve threatened and endangered species and their ecosystems.

The Safe Drinking Water Act Amendments of 1996 provides states with more resources and authority to enact the Safe Drinking Water Act of 1977. This amendment directs the State to identify source areas for public water supplies that serve at least 25 people or 15 connections at least 60 days a year. The Wyoming Department of Environmental Quality is responsible for regulatory enforcement of this law.

Executive Orders

Executive Order 11988 directs federal agencies to provide leadership and take action on federal lands to avoid, to the extent possible, the long and short-term adverse impacts associated with the occupancy and modification of floodplains. Agencies are required to avoid the direct or indirect support of development on floodplains whenever there are reasonable alternatives and evaluate the potential effects of any proposed action on floodplains.

Executive Order 11990, as amended, requires federal agencies exercising statutory authority and leadership over federal lands to avoid to the extent possible, the long- and short-term adverse impacts associated with the destruction or modification of wetlands. Where practicable, direct or indirect support of new construction in wetlands must be avoided. Federal agencies are required to preserve and enhance the natural and beneficial values of wetlands.

Regulations and Policies

Regulations and policies have been passed in support of these laws and require the following:

- ♦ Protection of surface resources and productivity from all natural resource management activities (36 CFR 219).
- ♦ Limitations on land management activities to protect watershed condition. Forest Service Manual (FSM) 2500 and Forest Service Handbook (FSH) 2500 state policy and direction regarding watershed management.
- ♦ Watershed analysis as part of all planning activities (36 CFR 219, FSM 2500).

Resource Protection Measures

Region 2 of the Forest Service has developed a Watershed Conservation Practices Handbook (WCPH) (FSH 2509.25), which provides direction for resource managers within the context of existing laws, regulations, and policies. The WCPH lists standards and design criteria designed to protect, maintain, and enhance the integrity of soil and aquatic ecosystems. Standards and design criteria are referenced under a guideline in the Revised Plan. According to the Handbook, streams and watersheds that exhibit the following three conditions are at “potential” and in a dynamic equilibrium:

- ♦ **Integrity of streamflow** – expressed as minimum flood runoff and maximum base flows. Healthy watersheds have high rates of infiltration and minimum surface runoff. Most precipitation soaks into the soil, which reduces flooding, recharges groundwater, maintains riparian and wetland areas, and regulates streamflow.
- ♦ **Integrity of the fluvial system** – expressed as stable stream networks and channels and a balance between runoff and sediment yield. In healthy watersheds, the stream network is not expanding through gully erosion; streams are not aggrading or degrading; channel capacity is maintained over time, and streambanks are well vegetated.
- ♦ **Integrity of water quality and aquatic habitat** – good stream health supports productive, diverse, and stable populations of aquatic life and displays a natural range of habitat features (pool depth, substrate composition, and sequences of pools and riffles) for aquatic organisms.

The *Aquatic, Riparian, and Wetland Ecosystem Assessment* produced by Winters and others (2004), has also identified specific watersheds with unique aquatic ecological qualities. The Assessment classifies small watersheds into distinct groups differing in aquatic resource productivity, abundance, and response to disturbance. This concept provides a stratification of these resources within the Forest landscape. In conjunction with the watershed assessment, current and existing human influences on the landscape were also analyzed. A synthesis of the watershed characteristics and human influences assessed the sensitivity, importance, and management risks associated with aquatic and riparian resources. This analysis will be

invaluable for identification of priority areas for restoration, monitoring, and provide a context for future management direction (Winters et al. 2004).

A Non-point Source Management Strategy is also included in the WCPH (FSH 2509.25 Chapter 20). The strategy addresses how the Forest will apply the Handbook, monitor its implementation and effectiveness, and adjust land management activities, as needed, to meet state water quality standards. The WCPH was written to protect aquatic resources and to address the potential and actual effects of land management activities such as livestock management, timber harvest, water developments, engineering, and recreation on aquatic resources. When the applicable measures are effectively implemented, adverse effects to aquatic resources will be minimized or eliminated.

Implementation and effectiveness monitoring of BMPs are typically carried out as an administrative review and do not involve quantitative water quality measurements (MacDonald et al. 1991). Implementation and effectiveness monitoring of BMPs, the practices outlined in the WCPH and Forest Plan standards and guidelines can be carried out by a variety of personnel, including timber sale administrators, contract officer representatives, resource specialists, and line officers. Documentation of this monitoring might include field notes, memos, contract daily diaries, or the annual Forest monitoring report. Systematic monitoring and adjustment of land management activities to protect soil and aquatic resources will ensure the highest possible level of BMP implementation and effectiveness.

AFFECTED ENVIRONMENT

This section gives a brief overview of Forest surface water, groundwater, water developments, riparian areas, and aquatic biota. Natural disturbances and human influences that affect aquatic resources are also discussed. The physical, chemical, and biological integrity of Forest aquatic systems are assessed and key risks are identified. See Winters et al. (2004) for a detailed assessment and analysis of aquatic, riparian, and wetland ecosystems on the Forest.

Surface Water

There are approximately 1,400 miles of perennial streams in public lands within the Bighorn National Forest. Water originating on the Forest contributes to flow to the Upper Missouri River basin. The east side of the Forest is in the Powder River and Tongue River drainages, whereas the west side of the Forest is in the Bighorn River drainage. There are also hundreds of lakes, reservoirs, and ponds distributed across the Forest.

The Wyoming Department of Environmental Quality (WYDEQ) identifies streams which do not meet designated beneficial uses, because of water quality impairment and impaired stream segments are described in the 305(b) Water Quality Assessment Report and 303(d) List. Within the Forest boundary, there are currently two streams on the Forest, which have been identified as impaired as they are not supporting contact recreation use, due to high levels of the indicator

bacteria, *E. coli*. The two stream segments, Granite Creek, from its confluence with Shell Creek, upstream approximately four miles, and the North Tongue River, from confluence with Bull Creek, upstream an undetermined distance, are described in the 2004 305(b) Water Quality Assessment Report and 303(d) List (WYDEQ 2004). Hunter Creek was listed as threatened on the 2002 303(d) List, for excessive sediment, but has since been removed, as a result of road relocation efforts in 2003.

Surface water from the Forest is used on and off-Forest, both consumptively and non-consumptively. Non-consumptive uses include recreation, wildlife, fisheries, channel maintenance, and the aesthetic and spiritual quality of the resource. Consumptive uses meet Forest Service administrative needs (campgrounds, firefighting, administrative sites), permitted activities on the Forest (stock watering facilities, summer home wells, snowmaking at ski areas), and off-Forest activities (irrigation, municipal water supplies) with permitted water diversion, transmission, and storage facilities on the Forest.

Groundwater

The majority of the Forest is underlain by Precambrian aquifers. Precambrian rocks are not a major aquifer; therefore, groundwater storage across most of the Forest is localized and limited. Development of groundwater resources on the Forest tends to only occur in shallow alluvial aquifers.

Groundwater quality information for the Forest is limited, although there is extensive off-Forest data available for the more extensive aquifers. Campground wells on the Forest have been tested for baseline water quality. Results of those tests indicate that primary drinking water standards (e.g., iron) are occasionally exceeded. Past management on the Forest has not had any significant adverse effects on groundwater.

With the limited supply and lack of development opportunities, beneficial use of Forest groundwater is low. Consumption is limited to stock-water facilities, spring developments, special-use permits, and Forest Service campgrounds and administrative sites with domestic wells. Off-Forest, groundwater is used extensively for pump irrigation and drinking water wells.

Water Developments

Development and use of Forest water resources can affect water quality and quantity. Reservoirs and other structures used to store or divert water, are abundant off the Forest; however there are relatively few diversions within the Forest boundary. This is due to the lack of agricultural and municipal development within the Forest boundary, as well as the physical difficulty and expense of transporting water to private lands that are off of the Forest. A total of 27 diversions are located within the Bighorn National Forest boundary (Winters et al. 2004). There are at least 10 reservoirs on the Forest that are used for agricultural and municipal purposes, with flows being carried down existing streams with a few connecting diversions.

Springs and associated wetlands are typically developed for administrative purposes and recreational residences. Development directly impacts these areas by altering the natural

system including hydrologic regime, soil condition, and plant associations. Developed springs often lose their unique hydrologic characteristics, and may be transformed to upland habitat in extreme situations (Winters et al. 2004).

The majority of water development on the Forest is associated with agricultural and municipal uses beyond the Forest boundary. Agricultural uses include stock watering and irrigation. Stock watering facilities are common on the Forest and are usually small wells or spring developments. Irrigation water diversions tend to be simple headgate designs and open, earthen canals to transmit water for use off-Forest. Agricultural water uses tend to divert water only during the summer months. Municipal water diversions take place year-long and tend to be sophisticated, with multiple diversion structures feeding into larger and larger canals and pipelines and typically include use of reservoirs to store the water.

Municipal Watersheds

A legal requirement listed under 36 CFR 251.9 states that “The Forest Service shall manage National Forest watersheds that supply municipal water under multiple use prescriptions in Forest Plans.” Although the WYDEQ does not officially designate municipal watersheds for domestic use, they do designate Class 2AB waters. Class 2AB waters are those which have sufficient water quality and quantity to support drinking water supplies and those waters are specifically protected for that purpose. Watershed protection is provided for municipal supply watershed through adoption of the the WCPH standards and guidelines during project level implementation. 36 CFR 251.9(a) also provides additional direction, that in order for a municipal water supply to receive additional protection measures, a “municipality must apply to the Forest Service for consideration of these needs.”

Five cities located at the base of the mountains rely on surface water that originates on National Forest lands. The following watersheds have been identified by the state and the Environmental Protection Agency as being suitable for drinking water, serving community water systems.

Table 3-4. Watersheds serving municipal water systems.

Watershed Name	State of Wyoming Surface Water Classification	Municipality/Facility Served by Forest Watershed
Goose Creek	Class 2AB	Sheridan, WY VA Medical Center
Tongue River	Class 1	Dayton, WY Ranchester, WY
Clear Creek	Class 2A	Buffalo, WY
Shell Creek	Class 2AB	Greybull, WY Shell, WY

Riparian/Wetlands

Riparian areas are places where water-dependent vegetation lives and grows on the banks of stream, lakes, and rivers and includes the watercourses themselves. Wetlands, such as swamps, bogs, marshes, and wet meadows, are areas that are frequently saturated or inundated by surface water or groundwater, which is sufficient to support a variety of characteristic plant or animal communities. Wetland plant and animal communities typically require saturated or seasonally saturated soils to survive. Most riparian areas are obvious because of their unique vegetation. In drier parts of the Forest, ribbons of dense vegetation flank streams and rivers, in distinct contrast to the surrounding uplands and valley bottoms. For the purposes of this discussion, riparian ecosystems, wetlands, lakeside zones, springs, and floodplains will be referred to collectively as riparian ecosystems or areas.

There is great variability in the size and vegetative complexity of riparian areas on the Forest. Ecological drivers such as geology, climate, glaciation, and stream gradient all influence the type, complexity, quantity, and distribution of these ecosystems. Glaciated landscapes on the Forest have a relatively higher proportion of wetland and riparian areas, due to an inherent landform of low gradient, wider valley bottoms (Winters et al. 2004).

Riparian ecosystems cover a relatively small portion of the Forest; but their ecological significance far exceeds their limited physical area. These ecosystems are an important component of the overall landscape and represent some of the most dynamic and ecologically rich areas across the landscape. Riparian ecosystems are highly responsive to both natural and human caused disturbances, although they can typically be restored more quickly than other habitats due to the interaction between, water, vegetation, and soils.

The following table displays the amount of riparian acres in each geographic area, totalling approximately 10% of the Forest.

Table 3-5. Acres of riparian area, by geographic area on the Bighorn National Forest.

Geographic Area	Acres of Riparian Area
Devil Canyon	5,594
Shell Creek	10,693
Paintrock Creek	10,883
Tensleep Creek	10,119
Clear/Crazy	14,257
Piney/Rock	10,704
Goose Creek	14,004
Tongue River	18,656
Little Bighorn River	9,686
Total	104,596

Although riparian areas occupy only a small part of the Forest, they are a critical source of diversity within ecosystems. Healthy riparian areas, with an abundance of trees and other native vegetation, slow flood waters and reduce the likelihood of downstream flooding. Riparian areas improve water quality by filtering runoff, sediment, and nutrients from flood flows and adjacent upland slopes. Healthy riparian areas act like sponges; they absorb water readily during periods of excess. Water slowed by riparian areas enters the groundwater table where it is released at a later time. Riparian areas produce stream cover and shade, which keep water temperatures cool for fish and water-dependent animals. Fish also depend on healthy riparian areas for stable channels and habitat, sustained water supplies, clean water, food, and shelter. Other benefits include food, cover, and nesting habitat for wildlife and migration corridors to other habitats. Riparian areas are also attractive and inviting to humans because of aesthetic and recreational purposes.

Maintaining the hydrologic regime is important for maintaining the integrity of riparian plant communities. Streamside riparian ecosystems are tied to the hydrologic, sediment, and disturbance regime of flowing waters and many riparian plant species reproduce only after flood disturbances. Changes in sediment load in stream channels may lead to down cutting or lateral erosion, altering floodplains and water table relationships. Non-streamside riparian areas occur in sites with seasonally or permanently high water tables, as well as on the margins of ponds and lakes. Wetlands are easily dewatered, which can allow for a conversion to upland plant communities or facilitate exotic plant invasion. Sediment deposition from adjacent slopes can “fill” riparian areas and provide suitable sites for upland and exotic plant invasion.

The conditions of riparian areas can be used to indicate ecosystem quality. Most riparian areas on the Forest are believed to be functioning at or near their potential and most degraded areas are improving. Although there is improvement in some areas, there are localized areas where these ecosystems may be functioning below their potential.

Factors leading to a decrease in riparian area function are: improper livestock grazing, timber harvest, road development, water diversions, and disturbances associated with recreational use. Improper livestock grazing has been a factor leading to some of the degraded riparian areas on the Forest. Improper livestock grazing can lead to bank damage, riparian plant community conversion, and sedimentation. On forested landscapes, silviculture, road building, and fire suppression have altered riparian conditions by changing flow regimes and altering channel morphology. When disturbances to the riparian area are significant, they may modify the interaction between the floodplain, water table, and the stream channel. Impacts to the riparian area can lead to a decrease in the function and habitats provided by a healthy riparian area. Natural disturbances as described above may combine to degrade riparian conditions, but are also necessary for causing regenerative events in these areas.

Riparian areas can often be key sites for invasion of exotic plant species due to the relatively higher level of human uses in these areas. Noxious weed invasion is less likely in higher elevations (>9,000 feet), with the exception of Canada thistle but increases at lower elevations due to climate differences (Winters et al 2004). Loss of native vegetation can disrupt the functioning of riparian areas because of decreases in root density, which are

important for stream channel stability, and changes in plant communities which may be important for local species. Refer to the Nonnative and Invasive Species section of Chapter 3 for further information.

There are 24 rare vascular plant species known to occur in wetlands on the Forest (Winters et al. 2004). Refer to the Biodiversity section of this chapter for further information on rare species. None of the plant species are known to be in decline from any current uses on the Forest in riparian areas, and some are deemed rare due to lack of information and surveys. Regardless, they are likely dependent on quality riparian habitat for persistence.

Roads can have a relatively high impact on riparian areas. Where greater densities of roads occur, there is a increased potential for degradation through a disruption in subsurface flow, plant communities, fine sediment input, and migration corridors. The overall road density in a watershed can be an indicator for these effects. Road densities are described in more detail in the Biodiversity section of this chapter.

The following table displays the current amount of roads within riparian areas on the Forest. While there was no threshold identified for concern in Winters et al. (2004), the figures below indicate which watersheds have relatively higher amounts of roads in riparian areas, and therefore a potentially greater risk of impaired conditions. The total amount of roads in riparian areas (157 miles) amounts to approximately 9% of all Forest road miles.

Table 3-6. Miles of road in riparian areas, by geographic area, on the Bighorn National Forest.

Geographic Area	Miles of Road within Riparian
Devil Canyon	6
Shell Creek	13
Paintrock Creek	8
Tensleep Creek	13
Clear/Crazy	32
Piney/Rock	2
Goose Creek	16
Tongue River	56
Little Bighorn River	11
Total	157

More specifically, another indicator of riparian condition and quality is the number of road crossings within a drainage. The higher the road crossing densities, the more likely there will be detectable effects in water quality. The following table displays the range of road crossing densities within each of the planning watersheds. Exceeding 0.5 stream crossings

per square mile of watershed appears to be a threshold after which higher risk of road related watershed impacts occur (Winters et al. 2004).

Table 3-7. Density of stream crossings, by geographic area, on the Bighorn National Forest.

Geographic Area	Number of Stream Crossings	Number of Stream Crossings per Square Mile
Clear/Crazy/Powder	276	1.4
Goose Creek	108	0.9
Tensleep Creek	174	1.5
Devil Canyon	86	0.9
Little Bighorn	165	0.7
Paintrock Creek	118	1.1
Piney/Rock Creeks	17	0.1
Tongue River	337	1.2
Shell Creek	173	1.0

The Forest has been actively reducing the number of crossings, and improving the condition of stream crossings for the past several years through its aquatic management program. It is presumed that this emphasis would continue into the next planning period.

Aquatic Biota

The Forest supports a variety of biota in its aquatic and riparian ecosystems. Man-made reservoirs on the Forest also provide habitat for aquatic biota, however their fluctuation in water levels can create environmental extremes favoring few of the species groups considered below. Clearly, the most common aquatic biota in the Forest can be broadly categorized as fishes, aquatic plants, aquatic insects, and the embryonic and larval stages of amphibians. Less obvious and even less understood are the phytoplankton, zooplankton, and microbes, which play a vital role in nutrient cycling and energy flow within the aquatic ecosystem. Amphibian species are discussed in more detail in the Biodiversity section of Chapter 3.

Historically, there were no documented fish populations in the high elevation lakes on the Forest (Gillette 1925), and indigenous fishes were typically found in streams. Fish have been the focus of the Wyoming Game and Fish Department (WGFD) and Forest resource managers for the past several decades. Demand species were introduced for sport fishing and have subsequently established self-reproducing populations. Yellowstone cutthroat trout and mountain sucker are native to the Forest and receive a higher level of management attention, due to habitat concerns and effects of competition of nonnative fish populations.

Brook trout were introduced into the Bighorn National Forest lakes beginning in the late 1800s. Later, nonnative demand species such as brown trout, rainbow trout, golden trout, splake, and Arctic grayling were stocked on the Forest (see table below). Several of the stocked, nonnative

trout populations were able to successfully reproduce in the high elevation, subalpine, lakes. Most of the available spawning habitat in these subalpine lakes is found in the stream channels flowing into and out of them. In subalpine lakes, nonnative trout may have adversely affected the abundance and distribution of native amphibians due to predation on larvae, juveniles, and adults.

Table 3-8. Fish species found on the Bighorn National Forest.

Species	Scientific Name	Status	Management Emphasis	Population Status
Yellowstone cutthroat trout	<i>Oncorhynchus clarki bouvieri</i>	Native	Emphasis species	Stocked and naturalized
Mountain sucker	<i>Catostomus platyrhynchus</i>	Native	Emphasis species	Naturalized
Shorthead redhorse*	<i>Moxostoma macrolepidotum</i>	Native	None	Naturalized
Longnose sucker*	<i>Catostomus catostomus</i>	Native	None	Naturalized
White sucker*	<i>Catostomus commersoni</i>	Native	None	Naturalized
Mountain white fish*	<i>Prosopium williamsoni</i>	Native	None	Naturalized
Longnose dace*	<i>Rhinichthys cataractae</i>	Native	None	Naturalized
Rainbow trout	<i>Oncorhynchus mykiss</i>	Nonnative	Management indicator species (MIS) and demand species	Stocked and naturalized
Snake River cutthroat trout	<i>Oncorhynchus clarki behnkei</i>	Nonnative	Demand species	Stocked
Golden trout	<i>Oncorhynchus aguabonita</i>	Nonnative	Demand species	Naturalized
Brook trout	<i>Salvelinus fontinalis</i>	Nonnative	Demand species	Naturalized
Lake trout	<i>Salvelinus namaycush</i>	Nonnative	Demand species	Stocked and naturalized
Brown trout	<i>Salmo trutta</i>	Nonnative	Demand species	Naturalized
Arctic grayling	<i>Thymallus arcticus</i>	Nonnative	Demand species	Naturalized
Lake chub	<i>Couesius plumbeus</i>	Nonnative	None	Naturalized

* Species are not common on the Forest, and are typically found in lower elevations near the Forest boundary.

Naturalized populations are either indigenous to the Forest or may be an introduced population of nonnative species, which are reproducing and have become self-sustaining. Stocked populations have been introduced by human intervention, but do not reproduce successfully.

Often, native species become a focal element of wilderness areas. Of the 314 high mountain lakes in the Cloud Peak Wilderness (Management Areas 1.11 and 1.13), 10 lakes contain naturally reproducing populations of Yellowstone cutthroat trout. There are 65 lakes that support naturally reproducing populations of other demand species such as golden trout, lake trout, rainbow trout, and brook trout. Twenty lakes are stocked but do not have naturally reproducing populations because they are prone to winterkill and require periodic stocking to maintain a recreational fishery. The remaining 244 lakes are presumed to have no fish, demonstrating that approximately 78% of the wilderness area lakes are managed for natural conditions.

Emphasis and Management Indicator Species

While the Forest Service manages the habitat component of the fisheries resources, the WGFD is has the charge to manage fish populations. Management of wetland and aquatic dependent species is an important, but extremely complex component of Bighorn National Forest management. To meet this challenge, the Forest has used several coordinated strategies to develop management direction, assess effects of management activities, and establish monitoring goals. Strategies include; identification of emphasis species (Yellowstone cutthroat trout and mountain sucker), selection of Management Indicator Species (rainbow trout), identification of sensitive species and other species at risk, and management of aquatic ecosystem processes. Aquatic emphasis species include three amphibians (leopard frog, spotted frog, and wood frog), Yellowstone cutthroat trout and mountain sucker, which are also considered sensitive species by the Forest Service and have associated rare status among several States. Rainbow trout and beaver were selected as a Management Indicator Species' (MIS) based on an established selection process (Revised Plan Appendix C). The administrative record contains further information on other species considered as MIS, including plankton, macroinvertebrates, and other fish species. Refer to the Single Species Analysis portion of the Biodiversity section of Chapter 3 and Revised Plan Appendix C, for more discussion on MIS and emphasis and sensitive species.

Yellowstone cutthroat trout, are considered unlikely to have historically occurred in the Powder River watershed. The historical distribution of this species on the remainder of the Forest has been substantially reduced, and many local populations have been extirpated. There are existing populations of genetically pure, native, Yellowstone cutthroat trout on both the eastern and western side of the Forest. Most populations are small and isolated in short reaches of remote streams. Monitoring and inventory in association with the WGFD has led to a near complete survey of streams and lakes, to asses the species' distribution across the Forest. Based on limited information, from sample locations across the Forest, population trends are currently unknown. Populations are monitored in selected stream segments, of approximately 300 ft. in length, or lakes, with periodic sampling occurring at 3-5 year intervals.

Hybridization with rainbow trout and competition with nonnative species are believed to be the primary causes in the decline of this subspecies (Behnke 1992). Habitat degradation is a second factor important in the decline of this species. Activities such as dam

construction, water diversions, grazing, mineral extraction, road construction, and timber harvest have substantially fragmented or degraded environments across the historic range of Yellowstone cutthroat trout. These activities have resulted in barriers to migration, reduced flows, sediment deposition, groundwater depletion, stream bank instability, erosion, and pollution (Meehan 1991).

Recreational activities can also be a significant source of disturbance to aquatic habitats, through increases in user created trails with motorized vehicles or excessive bank trampling by pedestrians. Angling is another factor that may play an important role in the status of remaining Yellowstone cutthroat trout. Yellowstone cutthroat trout are particularly vulnerable to angling, and angler harvest has contributed to substantial declines in population abundance throughout the historical range of the species. This factor has been an element of management focus by the WGFD for the past several years.

Mountain sucker are not common across the Forest, and currently the only known populations occur in the South Tongue River drainage and Kearny Reservoir. This species has wide distribution in the drainages at lower elevations and is common throughout its range. Historic distribution of mountain sucker in the Big Horn Mountains is not known. Self-sustaining populations have been identified downstream from the Forest boundary in the Paintrock, Shell and Tensleep drainages on the western slope and in the Tongue and Powder River drainages on the eastern slope.

Rainbow trout, an introduced species, are well-distributed throughout most watersheds on the Forest. Though there are potential competition issues with the native Yellowstone cutthroat, rainbow trout were selected as an MIS because of their distribution and they are typically associated with high quality stream and riparian habitat. Population trends on the Forest are currently stable, as demonstrated through combined Forest and WGFD monitoring efforts. Population trends on the Forest are assumed to be stable. Monitoring efforts by the WGFD and Forest personnel, on a limited number of streams across the Forest, have not shown significant or obvious changes in population trends at the landscape scale. Populations are monitored in selected stream segments, of approximately 300 ft. in length, or lakes, with periodic sampling occurring at 3-5 year intervals.

Impacts described for the Yellowstone cutthroat trout would also be applicable for rainbow trout.

Natural Disturbance Processes

Human activities can directly or indirectly affect natural processes and the frequency, magnitude, and duration of catastrophic events. Natural events, such as landslides and wildfire can influence the hydrology, water chemistry, vegetative succession, and geomorphology of watersheds and aquatic systems (Schullery and Varley 1994). For example, wildfire can cause landslides and alter vegetation composition and structure, alterations that can cause watershed recovery to take hundreds of years (Swanston 1991).

The effects of these processes on habitat quality and productivity depend on the intensity and timing of disturbance events. Some disturbances occur regularly and are generally easy to

anticipate such as seasonal and annual precipitation, bankfull flows, etc. Other events occur less frequently and are more difficult to predict. These unpredictable events are usually triggered by major storms, large-scale vegetation disturbances, such as fire, windthrow, insects and disease, or changes in the earth's crust, in the form of earthquakes or volcanic activity (Swanston 1991). Another natural process is the ebb and flow of beaver occupancy in a watershed, where water tables are raised and ponded habitat increased, but stream incision may occur when beaver vacate an area and their dams fail. Due to the important role of beaver in riparian areas, they were selected as a MIS species and are described in more detail in the Biodiversity and Wildlife sections of this chapter and Revised Plan Appendix C.

These natural events can alter watershed processes, local channel configuration, and aquatic biota and the magnitude of a disturbance determine the degree of change that will occur in a watershed. For example, during extreme flood events, greater than a 50-year event, organisms seek refuge in safe places behind logs, large rocks, under banks, and among roots and flooded vegetation. Extreme flood events, though relatively infrequent, can alter the habitats and behavior of aquatic organisms. Research in Yellowstone National Park has documented the impact of the large-area wildfires on stream channels (Gibbons and Salo 1973, Bozak and Young 1994). Sudden changes in channel morphology occurred because of increases in flow, sediment, and debris. Increases in sediment concentrations have lethal effects on fish and aquatic macroinvertebrate populations. However, over time, these impacts may be beneficial if they increase the amount of nutrients in sterile streams and increase the available food supply for fish and macroinvertebrates.

Watershed response to disturbance is widely variable. Some watersheds are very sensitive to disturbance because they may have steep slopes and highly erodible soils. Other watersheds are more resilient and are capable of accommodating severe climate events or intense ground-disturbing activities.

ENVIRONMENTAL CONSEQUENCES

General Effects

Nearly all activities carried out on the Forest and described in this analysis have the potential to affect aquatic and riparian resources. Activities that alter the quantity, timing, and quality of water resources have the greatest potential for adverse effects, and the risk of adverse effects increases the closer the disturbance is to streams or wetlands. Environmental consequences of activities are expected to be proportional to the levels of activities that occur. This aquatic and riparian resource analysis focuses on effects from anticipated management activities.

Direct and Indirect Effects

Surface water, groundwater, floodplains, riparian areas, wetlands, and aquatic habitats for species are all closely related. Discussion of effects on these resources will be dealt with together since the pathways of effects that influence them are similar. When they are impacted differently, it will be specifically noted and described.

For each of the resource areas described below, the environmental consequences for aquatic resources are compared by alternative, based on key indicators of disturbance for each type of activity. In general, alternatives that propose greater levels of disturbance activities for various resource uses generally pose greater risk to aquatic and riparian resources.

Effects from Timber Harvesting: Timber harvest can affect aquatic resources in a variety of ways. Harvest in riparian zones reduces streamside vegetation, which can increase annual and daily stream temperature fluctuations, reduce overhead cover, and decrease the supply of large woody material available for recruitment to streams. Logging slash and debris can choke streams and reduce dissolved oxygen levels as debris decays, creating anoxic conditions toxic to fish and other aquatic organisms. With direction outlined in the WCP, the Forest has avoided harvesting in riparian areas during the past decade, so these types of effects are largely associated with more historic management activities. Further direction outlined in the Revised Plan, with a harvest limiting, 300 ft buffer, for habitat management purposes would provide additional protection for some riparian areas. Major increases in erosion from harvested areas themselves are unusual, but the road and skid trail network associated with timber sales can increase the risk of erosion and sedimentation.

Water resources have been influenced by historic tie drives and timber removal for other commodity uses. Timber harvest started in earnest with the advent of railroad tie hacking in the late 1800s. The log drives along with those instituted for saw timber, damaged stream banks, and simplified channel structure. A complete description of effects can be found in Young et al. (1989). The decline of tie drives in the early 1900s has allowed for stream recovery in many areas.

Changes to natural stream flow regimes, as a result of modifications to forest vegetation cover, can alter stream channel morphology, by altering the quantity, timing, and duration of flows. Bankfull discharges have been found to mobilize and transport the majority of annual sediment loads over a period of years (Andrews 1980), and other research found that the duration of bankfull discharge increased after timber harvest (Troendle and Olsen 1994). Despite the logical link between altered flow and sediment transport characteristics, there are no known documented cases of stream channel alterations on the Forest resulting from increased water yield following timber harvest. Flows to streams may often increase following natural or man caused reductions in forested cover within watersheds.

A stream's susceptibility to channel morphology change is dependent on its characteristics (Rosgen 1996). The majority of streams on the Forest are not highly susceptible to changes in morphology as a result of vegetation management, since they are well armored and often enlarged due to historic tie drives. Harvest levels necessary to produce measurable increases in streamflow only occur in very small watersheds across the Forest, where more than 20-25% of

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a watershed could potentially be harvested. Revised Plan standards and guidelines provide measures to protect stream channels against the impacts resulting from large scale vegetation management. Channel instability as a result of increased water yield from vegetation management is possible, but is not expected to occur in most areas on the Forest due to the small harvest levels in individual watersheds and the channel conditions present on most of the Forest. In the few cases where there may be concerns, project-specific analysis and mitigation should address channel instability resulting from increased water yield following vegetation management.

Increases in stream flow, changes in riparian vegetation, and impacts to streambanks associated with both historic and current logging operations have the potential to alter channel morphology and fish habitat in streams on the Forest. Direct effects of vegetation removal are most likely to result in reductions in overhanging vegetation that provides hiding cover, protection from extreme temperature fluctuations, and resting areas for fish, and reductions in the organic input of leaves, debris and insects to a stream. Indirect effects of streamside timber harvest to aquatic ecosystems could be changes in community composition and relative abundance of aquatic biota and reductions in the abundance, distribution, and quality of spawning habitat and hiding cover due to sedimentation, embeddedness, and loss of streamside vegetation.

Forestwide standards and guidelines have been developed to minimize the impacts of timber harvest activities on aquatic resources. Careful project planning and site specific project implementation are required to ensure that vegetation management does not preclude achieving desired conditions for aquatic and riparian ecosystems or adversely affect viability of aquatic emphasis species, MIS, or demand species. Implementation of effective watershed conservation practices and BMPs will also minimize the changes to aquatic ecosystems that could occur as a result of timber harvest.

The risk of adverse consequences to watersheds and fisheries may increase with higher harvest levels, as opportunities for conflict with standards or guidelines could occur, though this is primarily in relation to the associated road networks necessary for higher harvest levels rather than vegetative manipulation. The potential for impacts to water resources are estimated to be proportional to the acres of land allocated to suited timber and is shown in the summary of effects section below. It should be noted that Management Area 5.4 does not provide for suited timber within 300' of perennial streams, and suited timber is not typically available within 100' of both intermittent and perennial streams and other riparian and wetland areas for all management areas.

Based on overall amounts of timber harvest, Alternative E has the highest risk of effects to aquatic resources, from timber harvesting. This analysis assumes that the amount of harvest is proportional to the suited acres, allocations of management areas in Category 5, and that there is equal risk and consequence of effects from timber harvest and related activities carried out in all locations. In reality, the risks and consequences are dependant on a variety of project level factors, including the type of harvest and location relative to water resources. There is also a potential benefit of increased water yield in some watersheds, through a reduction in forested cover, but may be immeasurable. Although there is a potential benefit, there must be adequate storage capability to capture the higher flows, which are generated during spring runoff

occurring prior to irrigation needs, during the hotter summer months. Increases in water yield may also be undesirable because of ecological, regulatory, and social constraints.

Effective implementation of watershed conservation practices is critical to avoiding or minimizing impacts to aquatic species and potentially affected streams under any alternative. Implementation and effectiveness of forestry watershed conservation practices was rated at 91 and 93 percent respectively, in a recent field audit which included two timber sales on the Forest (Wyoming Timber Industry Association 2002). Actual areas harvested in any given year vary depending on alternative and budget levels. Site-specific effects on aquatic and riparian resources would occur as a result of a variety of factors including harvest levels and type, location of harvest relative to aquatic resources and effective implementation of watershed conservation practices. Currently, harvest activities have occurred on approximately 20% of the forested acres on the Bighorn National Forest (Regan et al. 2003).

Effects from Travel Management: Roads connected to the stream system are a source of increased sediment in streams on the Forest (Winters et al. 2004). Many streams have roads or trails directly adjacent to them as described in the Affected Environment above, where nearly all erosion delivers sediment directly to the stream. Sediment fills pools, reducing habitat for fish, and fills the interstitial spaces of the streambed, reducing habitat for invertebrates and spawning and rearing fish. Unlike many other disturbances that increase erosion, sedimentation from travelways tends to be chronic and to last as long as the travelways exist, which can create long-term impacts on habitat for indicator species. Roads, trails, and associated human travel also cause reduction, disturbance, and interruption of riparian habitat. Accordingly, numerous wildlife species associated with riparian areas are adversely affected.

There are both economic and ecological consequences from increased sediment derived from roads and other sources. Sediment does not dissipate and is carried through the stream system where it may affect diversion structures, reservoirs, and water supplies. It can shorten the usable life of structures or result in higher maintenance costs. Since channels are interconnected, sediment delivered to ephemeral channels moves on to perennial channels during spring runoff. High sediment loads impact stream health by reducing pool depths, filling interstitial spaces in the streambed used by macroinvertebrate life, adhering to gills of aquatic life, changing channel morphology, and damaging habitat.

Alteration of aquatic habitats for emphasis species, MIS, and demand species, by sedimentation includes reductions in spawning gravels and hiding cover as substrates become more embedded. Pool volume can be reduced as sedimentation increases. During critical low-flow or overwintering periods, reduced pool depth can result in insufficient protection for fish and increase the risk of fish kills. Sediment deposition in spawning gravels reduces both success in locating appropriate spawning areas and the survival of emerging juvenile fish.

The Forest is responsible for the management of approximately 1,544 miles of classified roads and 274 miles of unclassified, user-created routes. Most roads were constructed to support past timber harvest activities. In addition, there are numerous other roads managed by state or county agencies, within the Forest boundary, including U.S. Highways 14, 14A, and 16 and the Red Grade road. There are also approximately 1,211 miles of trails on the Forest. These travelways provide a background level of disturbance that contributes to direct and indirect

effects on aquatic and riparian resources. Trends in increased recreation are expected to continue and to accelerate these effects.

Compliance with Revised Plan standards and guidelines should minimize problems with new or reconstructed roads. However, bringing existing roads into compliance with new protection measures is a challenge. The *Bighorn National Forest Roads Analysis Report* (2002) provided an analysis of 6th-level watersheds on the Forest and found 21% with relatively high road densities, 20% with relatively high surface erosion potential, and 16% with relatively higher road densities within 200 feet of stream channels. Roads managed under other jurisdictions that occur on private land or run across easements also contribute cumulatively with Forest roads to watershed conditions.

Future road management should consider relocation or obliteration of existing roads out of riparian areas to reduce associated impacts. Impacts can be greatly reduced by proper location and design. Travelways should be located away from stream channels, riparian areas, steep slopes, high-erosion-hazard areas and areas of high mass movement. Good design provides stable cut and fill slopes and adequate drainage that allows water to filter through vegetated buffers or sediment traps before entering the stream channel. Realignment of roads and other travelways so that they traverse riparian areas and streams at perpendicular rather than parallel angles would improve the quality of riparian and aquatic habitats in presently impacted stream reaches by reducing chronic sediment sources. If relocation is not possible, seasonal restrictions would limit road damage and subsequent sedimentation.

The amount of road construction varies directly with the amount of suited land that has been allocated for timber harvest. Alternative E would have the most road construction of any of the alternatives considered, due to the relatively larger amount of timber harvest activity estimated. Alternative C would have the least amount of expected impacts.

Effects from Fire and Fuels Management: Wildfire and prescribed fires and their associated suppression activities have the potential to impact aquatic and riparian resources as described above in the natural disturbances section. By burning vegetation and organic matter on the soil surface, wildfire can temporarily cause an increase above natural erosion rates and adversely affect water quality. Erosion and sedimentation following high severity wildfires tend to be very heavy, overwhelming other erosional sources, including timber harvest and roads, until the land revegetates. Fire suppression efforts considerably increase erosion potential from fire lines constructed by heavy equipment. The removal of vegetation also increases the speed with which overland flow reaches the channel network and the amount of water added to the streamflow. The combination of these effects can greatly increase peak flows in burned watersheds and result in major upland and stream channel erosion. When fires burn through riparian areas, buffering vegetation is lost and effects on aquatic ecosystems can be even more severe. Adverse impacts can persist for many years.

The effects of prescribed fire can be considerably less severe. Because the location and severity of the fire are controlled to a greater degree, more ground cover remains and erosion potential is reduced. For example, sediment-trapping buffers can be left around stream channels to reduce the amount of sediment delivered to the stream. Entire watersheds are rarely burned by

prescribed fires, and this reduces the effects of changes in water yield and peak flow. The use of prescribed fire can help to reduce the risk of wildfire that would otherwise burn with increased severity and intensity, which can severely alter watersheds and riparian areas. Alteration of aquatic habitats for emphasis species, MIS, and demand species, by sedimentation resulting from wildfire, includes reductions in spawning gravels and hiding cover as substrates become more embedded and pools are filled with fine sediment.

Frequency, size, and severity of wildfire are difficult to predict for the short timeframes. It is estimated that approximately 1,190 acres will burn annually, based on recent fire history on the Forest. Smaller wildfires occur relatively frequently, while larger wildfires occur infrequently. Severe wildfire can have devastating consequences to aquatic ecosystems. Management response to wildfire varies between alternatives and will likely affect the size and severity of wildfire expected under each alternative. Refer to the Fire and Fuels section of this chapter for additional information.

Prescribed burning is intended primarily to improve wildlife habitat or reduce fuel loads. Fuels treatments may reduce the risk of severe wildfires and therefore have a positive long-term effect on aquatic conditions. In watersheds where the fuel conditions have been substantially altered, the long-term benefits of fuels treatments to aquatic resources are assumed to outweigh the short-term adverse impacts. Reductions in forested stands can also provide increased water flows that may be beneficial for aquatic resources. Fire suppression activities are typically conducted to minimize impacts to riparian areas by restricting the use of dozer lines and retardant in riparian areas. When retardant is allowed to reach water sources, aquatic biota may be impacted as a result from changed water chemistry and quality. Potentially undesirable aquatic biota may also be transferred from one water source to another, from the use of helicopter buckets during fire suppression. This type of activity is not restricted on the Forest.

In addition, the area affected annually by fuels management, considering a combination of prescribed fire and mechanical treatment, is expected to vary by alternative. Those alternatives with the most fuel treatment acres proposed are Alternatives B and D-FEIS, while Alternative C proposes the least (see the Fire and Fuels section of this chapter). Alternatives with more management area allocations that emphasize natural processes, such as Alternative C, have the highest potential for, and the most acreage potentially impacted by wildfire, by maximizing the number of areas where natural processes would dominate. Due to the unpredictable nature of wildfire, it is impossible to assess, with any degree of accuracy, where or how intense the direct and indirect effects of this process might be.

Effects from Livestock and Big Game Grazing: Improper grazing can have detrimental effects on aquatic resources, particularly in those areas of the Forest where livestock tend to concentrate, such riparian areas. Alternatively, proper livestock, wildlife, and rangeland management can mitigate the grazing impacts to riparian areas and can be compatible with maintaining desired watershed conditions. Grazing in riparian areas directly affects vegetative condition and habitat quality in a number of ways. Improperly managed livestock grazing can also lower water quality by introducing bacteria and pathogens, included in fecal material, into surface water.

Long-term use has changed the vegetation composition of some riparian sites. A loss of deep-rooted grasses and shrubs has made the streambanks in these sites more susceptible to the natural erosive forces of water. Improper grazing by livestock and wild ungulates can reduce bank stability through vegetation removal and bank trampling. Livestock and other ungulates can compact soil or destabilize streambanks by direct hoof action, causing increased sediment, stream widening or downcutting of stream channels, and often change riparian vegetation, resulting in insufficient overhead cover for fish. Stream widening and sedimentation can reduce instream cover and habitat quality for fish through mechanisms similar to those described for vegetation removal through timber harvest or fire, but grazing impacts can be compounded by repeated yearly livestock use of the same areas. Downcutting often leads to channel straightening and reduced stream sinuosity, which eliminates habitat for aquatic species.

Alternatives do not vary in the number of active allotments, number and type of animals permitted, or overall use by livestock. All alternatives maintain the current number of active allotments, 83 in total, and impacts from grazing would be similar to the existing condition. Livestock grazing under any of the alternatives is assumed to have direct and indirect impacts on riparian and aquatic resources and incorporation of the Revised Plan standards and guidelines into project level analyses will minimize the impacts on aquatic resources. The standards and guidelines are designed to protect water quality and riparian areas, and will be included in allotment-management plans as they are revised and updated. Although the number of livestock does not vary by alternative, it is anticipated that all alternatives would result in some improvement of riparian resources over time, through implementation of the standards and guidelines. Competing uses of riparian forage by livestock and wildlife were also addressed in the Revised Plan, and are estimated to be relatively minor, localized, sources of impacts.

Effects from Mining: The largest activity associated with mining on the Forest, is limited to exploitation of mineral materials for road construction purposes or individual permits for landscaping use off-Forest. Gravel pits are located in areas with minimal impacts to aquatic resources and the development of mineral materials is not expected to be large with any Alternative, but would potentially have the most impact under Alternative E, which has the least amount of area withdrawn from locatable mineral development

Existing mining operations, for locatable minerals, in the Forest are typically small and limited in number. At present, much of the mining for locatable minerals on the Forest is recreational and regulated by Revised Plan standards and guidelines. Increases in mining activity are not anticipated for the future, but cannot be ruled out. The 1872 Mining Law limits Forest Service authority over mining activities but allows the setting of terms and conditions to minimize impacts to National Forest System lands.

Most mining activity is concentrated outside the Forest in the sedimentary formations surrounding the Big Horn Mountains (Winters et al. 2004). The following table shows the number of mining sites inside and outside the Bighorn National Forest.

Table 3-9. Mining sites inside and outside the Bighorn National Forest, historically and recently.

Watershed Name	Historic Mining		Recent Mining	
	Inside Forest	Outside Forest	Inside Forest	Outside Forest
Nowood River	7	51	1	15
Bighorn Reservoir	4	106	3	72
Little Bighorn River	7	35	0	31
Upper Tongue River	22	139	2	13
Middle Fork Powder River	1	100	0	30
Crazy Woman Creek	1	24	0	20
Clear Creek	5	56	0	17
Totals	47	511	6	198

Source: U.S. Geological Survey, 1997 Mineral Availability System Database

Mining effects include land disturbances and processing activities that may affect water quality, water quantity, and timing of release. For this analysis, aquatic resource effects from mining are assumed to be proportional to the amount of land available for locatable minerals. Potential impacts to aquatic habitats and populations are expected to be minor for all alternatives as there are no expected proposals for large mineral development operations because of minimal, if not non-existent, potential for development of these resources. Alternative E would have the most area available for locatable minerals exploration and therefore has the greatest risk of adverse affects. Alternative C has the least amount of area available for locatable minerals exploration and therefore, has the least risk of adverse effects from this activity. Standards and guidelines would provide direction on minimizing the effects from mining activities, should they occur.

Effects from Oil and Gas Leasing: Because there has been no oil and gas activity on the Forest in the limited area that has development potential, oil and gas development on the Forest is not anticipated during this planning period. Therefore, there are no effects on aquatic resources from oil and gas leasing.

Effects from Utility Corridors: Three general types of utility corridors have varying potential to affect aquatic and riparian resources. Above-ground power and telecommunications corridors require vegetation clearing, but ground disturbance is limited to access routes and pole or tower locations. Streams and wetlands can often be spanned with no need for disturbance.

Below-ground power and telecommunications corridors require ground disturbance along the entire length of the corridor, including crossings of aquatic or riparian ecosystems. However, these corridors require relatively narrow trenches and minimal vegetation clearing. These utility corridors can often be located along other existing corridors such as roadways.

Below-ground oil, gas, or water transmission lines are most likely to significantly affect aquatic and riparian resources. These corridors often contain far larger pipelines that require large, deep trenches. To allow for gravity feed, these corridors are often located parallel to natural stream courses. Wide construction and access corridors are sometimes maintained to allow for repairs

and cleaning. Within the oil/gas pipeline corridors, there is potential for leaks or spills that could cause environmental damage.

There are very few utility corridors on the Forest. Increasing urbanization makes it likely that there will be an upward trend in utility corridors. There is not likely to be any difference in utility corridor proposals between the alternatives because corridors are instigated and developed by private utilities rather than by Forest management direction.

Effects from Recreation: Most developed and dispersed recreation sites are correlated with proximity to streams lakes or valley bottoms. The potential influence of developed and dispersed recreation sites on aquatic resources is variable across the Forest. It is recognized that some sites do tend to be located in riparian habitats and so corresponding influences would be anticipated there (Winters et al. 2004). Dispersed recreation sites are expected to have more negative impacts on aquatic resources, due to the fact that they were not established with specific design criteria or regulations and thus do not provide the same level of resource protection as developed sites.

Recreation impacts to water resources on the Forest are related to streamside recreation use, water-based recreation, and indirect effects from upland recreation activities. Motorized off-road recreation travel can cause riparian area degradation and adverse water quality impacts. Horse, bike, and foot traffic generally have less impact but can cause localized effects. Water-based recreation is increasing and degradation can occur if proper facilities are not in place and use is not managed. Streamside areas are often chosen for dispersed campsites. Dispersed campsite use can damage riparian vegetation, cause soil compaction in riparian zones, erode streambanks, and cause increased nutrient loading and pathogen levels due to human waste contaminating streams and lakes (Helgath 1975, Clark and Gibbons 1991, Leung and Marion 1996, Cole 2000). Often, the impacts tend to be localized; however, in areas that experience substantial recreational use, the cumulative impacts to aquatic and riparian ecosystems can be both observable and measurable. Protection of water quality, quantity, and riparian habitat near recreationally significant aquatic and riparian ecosystems is achieved through the implementation of the Revised Plan standards and guidelines.

Reduced recreational and scenic values, due to livestock excrement and trampling of streambanks and soils may occur, in addition to environmental impacts of erosion and reductions in water quality through bacterial inputs, nitrate pollution, fine sediment from erosion, and increased water temperatures that can occur with a loss in streambank vegetation.

Recreational use is expected to increase on the Forest and be essentially similar between alternatives. The direct impacts to fish populations and fishing experiences are expected to be proportional to use rather than variable by alternative. Ski area effects by alternative are discussed below. Impacts on riparian and aquatic habitats from recreational travel were discussed previously under the Travel Management section above. The magnitude and extent of motorized recreation trends have a greater effect on aquatic resources than nonmotorized recreation, and has been potentially one of the largest increases in uses from the conditions in the 1985 Forest Plan. Recreation impacts on aquatic, riparian, and fish populations, including emphasis species, MIS, and demand species, are assumed to be proportional to the acres available to motorized recreation.

Alternative E has the highest risk for potential adverse effects to aquatic resources from summer motorized recreation, based on anticipated opportunities for motorized recreation (Management Areas 1.33 and 3.31), as described in the Recreation section of this chapter.

Fishing is a primary reason for people to visit the Forest, although a consequential activity associated with other recreational pursuits, such as backpacking, camping, and horseback riding. Easy access to streams, lakes, and reservoirs provides a variety of angling opportunities situated in locales that range from developed sites with amenities to subalpine wilderness areas. Fishing can contribute to the propagation and distribution of pathogenic agents such as the whirling disease protozoan, coliform bacteria, New Zealand mud snail, and chitrid fungus in aquatic environments, all of which may damage aquatic biota.

Fishing pressure on the Forest is expected to increase in the coming decades under all of the forest plan alternatives. Except for stocked lakes and reservoirs, fishing is a “supply-limited” activity because there is more fishing pressure on easily accessible fisheries than the fish populations can support. The WGFD manages the majority of streams on the Forest under the “Wild” management concept; i.e. stocking does not augment fish populations. The WGFD has also placed special regulations on some streams to offset the pressure of angling, such as in the North Tongue.

Recreational fishing may adversely affect existing populations of Yellowstone cutthroat trout, and emphasis species, rainbow trout, a MIS, and demand species on the Forest, because increased recreational fishing pressure is likely to result in increased illegal harvest and increased incidental fishing mortality, although periodic restocking by the WGFD may be used to offset this or other fishing impacts. Refer to the Biological Evaluation in the project record for further information on Yellowstone cutthroat trout.

Nonmotorized trails are popular among Forest users in the Bighorn National Forest, and it is reasonable to expect increasing public demand for additional hiking trails over the coming decades. If those demands are met, the expanded trail networks and increased trail use could result in the alteration and degradation of aquatic, riparian, and wetland resources. Finally, trails can provide relatively easy access and opportunities for those who would introduce exotic species into aquatic environments. It is not anticipated that there would be a significant increase in trail construction in the next planning period, due to the deferred maintenance backlog associated with the Forest’s existing system routes. New trails may be developed along scenic byways and adjacent to the existing highway corridor, but most other trail construction is anticipated to be reconstruction of existing routes.

Winter recreation activities have some potential to adversely affect aquatic and riparian resources. Nonmotorized winter uses include cross-country skiing and snowshoeing. Motorized winter uses include snowmobiling and snow cat use for research and maintenance. Damage to vegetation and soil erosion can occur if there is inadequate snowpack to protect these resources. Winter motorized activities can also compact the snow, forming barriers that alter spring runoff patterns, which can result in soil erosion and gullies.

Contamination by human waste and by petroleum products such as motor oil and gasoline can degrade water quality in waters adjacent to areas of concentrated use such as parking lots and

snowmobile staging areas (Hagan and Langeland 1973, Ingersoll et al. 1997). The likelihood and magnitude of impacts due to these activities are dependent on site-specific factors such as average slope, aspect, elevation, vegetation, weather conditions, available facilities, and the amount of use. Because site conditions vary, and because these sites are relatively small in area and widely dispersed, it is reasonable to assume that cumulative impacts will not be measurable at the Forest scale. Appropriately, winter activities that appear to be problematic will be identified and rectified during project-level analysis.

Developed winter recreation sites may adversely affect aquatic and riparian resources. The Bighorn Ski Resort and Antelope Butte are ski areas that are permitted to operate on the Forest. Ski area development can lead to increased runoff and erosion through timber clearing for lifts, runs and other facilities. Ski areas and snow resorts typically remove forest vegetation from much of the area. Snowmelt runoff is increased, especially when cleared areas are compacted or snowmaking has artificially increased the snow depth. Substantial amounts of such disturbances can increase the size and duration of spring high flows, resulting in damage to the stream channel. Snowmaking that drains water from streams also reduces winter base flows that are limiting to populations of emphasis species, MIS, demand species, and other aquatic biota. Ski areas and snow resorts also typically disturb soils throughout cleared areas. Erosion and sediment can result, especially from soils that are near streams, unstable, or highly erodible. In addition, these uses can also degrade wetlands and riparian areas by draining or filling them or by altering their vegetation. Often, ski lift terminals are constructed in valley bottoms, which can cause long stretches of stream to be put in culverts, with a resultant increase in barriers to fish passage and loss of riparian and wetland habitat. These impacts often have adverse effects on aquatic and wildlife habitat.

All alternatives would continue to permit the existing ski areas. These are of small enough size that there are minimal current impacts to aquatic resources from their use. There is no anticipated expansion of the ski areas beyond that which is currently approved. However, the boundary of the Bighorn Ski Resort ski area is expanded in all alternatives except A. Any future expansions would be designed to mitigate effects to aquatic resources, though some potential would exist for adverse effects due to the proximity to Meadowlark Lake.

Effects from Wilderness and RNA Allocation: Alternatives C and D-FEIS are the only alternatives that includes additional wilderness recommendations. Within the areas proposed for wilderness, there are approximately five stream reaches that provide habitat for Yellowstone cutthroat, which would potentially benefit from this alternative. However, these same streams in almost all of the other alternatives are managed through roadless or equivalent non-motorized recreation emphasis prescriptions. None of the alternatives provide wild and scenic river recommendations for streams that contain Yellowstone cutthroat trout or mountain sucker.

Alternatives B, C, D-DEIS, and D-FEIS provide more opportunities for Research Natural Areas (Management Area 2.2), which might provide additional habitat protection or Yellowstone cutthroat trout populations. These designations would have similar effects for rainbow trout, a MIS, in terms of minimizing potential disturbances from more aggressive land uses.

Effects from Land Use Authorizations: Various laws provide for rights-of-way over public lands. The Forest Service is responsible for all existing grants and permits located on National

Forest lands, including their administration, amendment, and renewal when authorized and appropriate.

Water developments on the Forest include irrigation diversions and irrigation-storage reservoirs. Diversions reduce or eliminate downstream flows, which can affect channel size and limit habitat for aquatic and riparian management indicator species. Dams alter flow regimes by storing water during runoff for release later in the year. Both dams and diversions can impose significant barriers to migrations and can dewater streams during certain time periods, which fragments aquatic ecosystems. In some cases, altered flow regimes prolong periods of runoff and can enhance riparian vegetation communities.

Dams affect stream channels in different ways depending on their operation. Reservoirs store sediment and release sediment free water from the dam. As the water is released, it can downcut or widen the channel below the dam. On the other hand, if water storage reduces peak flows, the result can be the stabilization or reduction of channel capacity.

The 1985 Forest Plan contained provisions to protect aquatic habitats and stream channels from the potential adverse effects of water development. The Forest has reviewed some water use permits to ensure that aquatic habitats and stream channels are protected and to assess whether the uses were meeting forest plan standards. Some permits contain resource protection flow conditions and conditions to prevent gully erosion.

The Forest Supervisor has the authority to assure that permits for water developments are consistent with the Revised Plan and other applicable laws or regulations. As permits are amended, renewed, or issued, the Forest will analyze the environmental effects of those proposals and determine if mitigation or other terms and conditions are necessary. In some cases, the terms will focus on single permits; in others, they may address all permits in the watershed. While the effects of these projects can be significant, effects are not expected to vary between alternatives as demand for water-use authorizations is driven by proponents of water development rather than by Forest programs or budgets and many facilities are operated under easements or other authorizations subject to limited environmental mitigation. There may be future proposals to construct reservoirs or diversions on the Forest, however there are currently none pending.

Summary of Effects to Aquatics from Proposed Management Activities

Precipitation falls on all parts of a watershed and water flows over and through the soil mantle throughout the watershed on its path to stream channels. Consequently, aquatic resources are influenced by all the activities in the watershed.

The most significant improvement in the Revised Plan is the incorporation of forestwide standards and guidelines to protect aquatic and fisheries resources. These elements were not in the 1985 Plan. If all applicable measures are implemented and if they are effective, adverse effects from any of the alternatives should be minimized, and habitat should improve over time.

Accordingly, it is anticipated that there would be no difference in population trends or habitat available to the rainbow trout, a MIS, or the Yellowstone cutthroat trout among alternatives. All of the effects described above would have the potential to occur to habitat and possibly

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impact individuals of these two species on localized projects. However, based on the relatively low intensity of management activity at the forestwide scale, it is not likely that any changes in populations would occur based on planned management activities. All of the alternatives would maintain and allow improvement of habitat for the fish species, as desired by forest-wide objectives and strategies. However, greater risk is associated with more intensive activities taking place in riparian corridors, as described below. Catastrophic events such as flooding, landslides, disease, or competition with other species would likely dominate in terms of effects to these species, and their habitat and population trends.

Activities that disturb the soil surface have the greatest potential to affect these resources if activities occur in proximity to stream channels. These effects are typically expressed as inputs of fine sediment where roads are constructed along stream channels and have an associated stream crossing or other surface disturbances. Watersheds whose physical, chemical, or biotic function is at risk may be near their capacity to assimilate further impacts, or may need remedial action to reverse a downward trend. As activity levels increase, BMPs may not be entirely effective. Therefore, alternatives that propose higher levels of land disturbing activities pose greater inherent risks to aquatic and riparian resources.

The following table provides a summary of the relative impacts of alternatives on aquatic resources. The land use categories are ranked in order of existing and potential impact to aquatic resources on the Forest. The top line indicates highest degree of impact and bottom line indicates lowest degree of impact.

Table 3-10. Relative impact of alternatives on riparian and aquatic resources.

Land Use Category	Less Impact ← Relative Impact → More Impact to aquatic resources					
Effects from land authorizations	No difference between alternatives					
Effects from motorized recreation mgmt. (potential for user created roads)	C	B	D-FEIS	D-DEIS	A	E
Effects from livestock grazing	No difference between alternatives					
Effects from timber harvesting (tied to road effects)	C	B	D-DEIS	D-FEIS	A	E
Effects from timber harvesting (tied to vegetation management)	C	B	D-DEIS	D-FEIS	A	E
Lands allocated to Management Area category 5	C	B	D-DEIS	D-FEIS	A	E
Suited timber by Alternative	C	B	D-DEIS	D-FEIS	A	E
Effects from prescribed fire	C	A	E	D-DEIS	D-FEIS	B
Effects from wildland fire	B	D-DEIS	D-FEIS	E	A	C
Effects from utility corridors	No difference between alternatives					

Land Use Category	Less Impact← Relative Impact →More Impact to aquatic resources					
Land available for locatable minerals*	C	B	D-DEIS	D-FEIS	A	E

*Locatable minerals are minerals such as gold, silver, colloidal clay, and molybdenum

Alternatively, it could also be expressed that additional acres managed for natural processes such as wildfires could allow widespread fires that may have negative effects to aquatic resources. However, based on the variability in severity of fires, and the fact that the majority of the Forest is within a condition class rating (refer to fire and fuels section, Chapter 3) that is not outside of historic fire regimes, these effects should be minimal. Alternatives that maximize natural processes are Alternatives C, and B tapering off to D-DEIS, D-FEIS, A and E respectively.

Cumulative Effects

In some cases, events on the Forest can contribute to effects downstream off of the Forest. The cumulative effects table at the beginning of Chapter 3 includes the list of past, present, and reasonably foreseeable future activities that were considered with regard to cumulative effects to aquatic resources. An example is the effect of water depletions from water development on the Forest reducing streamflows available off of the Forest. As there are no anticipated water depletions proposed by the Forest, there should be no increases in this effect in the next planning period. Currently, these types of depletions off-Forest are affecting aquatic biota in many of the watersheds surrounding the Forest. Table 3-10 shows the relative effects of ground disturbing activities among all alternatives, where Alternative C is expected to have the least impact to aquatic and riparian resources and Alternative E would have the most effect on those resources. The effects are expected to be similar across the entire Forest, over the life of the Revised Plan, with regards to cumulative effects on aquatic and riparian resources.

Unless specified differently, the cumulative effects analysis is for the period of expected plan implementation (10-15 years), and is bounded by the 5th level hydrologic unit code watershed boundaries, which typically close within about 10 miles downstream of the Forest boundary.

Another potential effect within the Forest, but not attributed to Forest management activities, is the urbanization or development of intermixed private lands within the Forest. Continued development of these lands for residential purposes has the potential to affect aquatic and riparian resources. Increased runoff and sedimentation from roads, roofs, and driveways, increased use of surface and groundwater, increased use of herbicides, pesticides, and fertilizers; and increased recreation uses on adjacent National Forest System lands can all be attributed to urbanization. If activities on intermixed private lands approach tolerance limits for watershed disturbance, additional activities on the Forest may be limited to avoid adverse and cumulative watershed effects. With the limited amount of intermixed ownership on the Forest, this effect should be minimal.

Another effect would be the reconstruction or development of additional highways within the Forest boundary. There can be both short term and long-term effects from this type of activity.

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No additional highways are planned within the Forest. Currently, there would be reconstruction of Highway 14 planned in the near future, through BMPs would presumably limit the effects to aquatic resources. Existing culverts along U.S. Highways 14, 14A, and 16 are considered barriers to fish passage in some streams that would hopefully be corrected in the future through reconstruction or other opportunities.

As further development is anticipated along the Forest boundary, there is potential for noxious weeds or other invasive plants and aquatic biota to spread upstream onto the Forest due to livestock, recreation, or wildlife use. This may be one of the more significant cumulative impacts in the next planning period, altering riparian vegetation communities and biota with associated affects to water quality. Pollution of streams downstream of the Forest should be a minor problem to on-Forest resources as gravity would dictate most of the effects.

Future management of aquatic resources will be dependent upon cooperation with other agencies and stakeholders. Most emphasis of Forest management is on the maintenance, protection, or enhancement of habitats, rather than the organisms that inhabit them, but the National Forest Management Act also requires maintenance of population viability. The Forest Service and cooperating agencies predicate the long-term maintenance and protection of Forest aquatic and riparian biodiversity from effective natural resource management.

Management of fish populations is the role of state and other federal agencies that rely on Forest management of habitats to meet overall viability goals. A specific example of cooperative management is protection or conservation of viable Yellowstone cutthroat trout populations, rainbow trout, and other demand species, such as brook, brown, golden, lake trout, and grayling. Cooperative recovery efforts, including fish stocking and fishing regulations that protect Yellowstone cutthroat trout are important to retaining this biological element of the Forest.

Habitat protection and improvement projects should focus on the needs of native species, MIS, and other demand species. Management decisions that affect these species should be made collaboratively, by the appropriate state and federal agencies or other stakeholders. Other threats to native and desired, nonnative species viability, such as invasive species, habitat loss, and pathogens should also be managed collaboratively.

Looking past the forest boundary to consider how the Bighorn National Forest direct and indirect effects add cumulatively to downstream water quality, the most important consideration is that the headwaters of streams and rivers are located on the Forest. There are no water courses that originate on lands of other ownership that flow onto the Bighorn National Forest. While the direct and indirect effects analysis shows that Bighorn National Forest activities affect downstream water, overall, the water quality leaving the forest is good as documented by Conservation District water monitoring. Impacts of subdivision, roads, and septic systems downstream of the National Forest boundary are considered to be more important contributors to water pollution than Forest activities.

Compliance with local, state, and water quality regulations will ensure that future management activities under any of the alternatives will continue to protect aquatic and riparian resources on the Forest and will not contribute to water quality degradation downstream of the Forest. Over all, it is anticipated that physical aquatic resource conditions will at least be maintained or could

be improved into the future, due to changes in management efforts, such as livestock grazing and timber harvesting practices and improvements in the Forest transportation system. Biological effects on aquatic species, such as disease, competition, and climate, are typically beyond the control of normal management actions and may have adverse effects on those species' populations.

Biological Elements

Biological and Habitat Diversity

Introduction

Biological diversity refers to "the full variety of life in an area, including the ecosystem, plant and animal communities, species and genes, and the processes through which individual organisms interact with one another and with the environment" (USDA Forest Service 1992). The Forest Service is charged with providing for diversity of plant and animal species (36 CFR §219.26) and providing habitat to ensure viable populations of species (36 CFR §219.19 and USDA Regulation 9500-04).

The Bighorn National Forest adopted a two-pronged approach to assessing and managing ecosystem and species diversity for this plan revision effort. This approach is consistent with direction from the Acting Deputy Under-Secretary for Natural Resources and Environment, USDA (Tenny 2001) and with other national direction (Holthausen 2002) in adopting current scientific knowledge into the planning process.

This approach works by first obtaining an understanding of ecological processes, described in the Ecosystem Analysis. Ecological processes functioning within a Historic Range of Variability provides for the most opportunity of beneficial habitats for species associated with those habitats. The second aspect, described in the Single Species Analysis, examines the provision for individual species viability, where species viewed as at-risk or as focal elements within the ecosystem are analyzed in terms of habitat and population conditions and trends.

The **Ecosystem Analysis** provides the decision-maker with information about the trends in ecosystem conditions that will be either reinforced or changed by taking or not taking various management actions. The ecological processes are placed in a management context through the examination of the historical range of variability (HRV) and the relationship between natural factors and management activities. Ecosystem function and diversity is the focus of the Ecosystem Analysis. It addresses the continued functioning of ecosystems and ecological communities within the planning area and its objectives are listed below:

- ♦ Identify ecosystem elements whose current condition differs from most common conditions based on HRV.

- ♦ Provide an ecosystem context for the Single Species Analysis.
- ♦ Quantify and describe the occurrence and distribution of ecosystem elements such as covertypes and habitat structural stages for the existing condition and the conditions that would result from the implementation of the alternatives, and compares them to historical conditions.
- ♦ Determine how each management area contributes to the maintenance of biological diversity and how combinations of management area allocations contribute to biological diversity.
- ♦ Provide findings regarding conditions that will provide habitat for all species and maintain ecological functions.

The **Single-Species Analysis** is an analysis of particular species and their habitats. These species have been identified as having a need for a more rigorous examination of viability due to their perceived rarity as a function of habitat or population conditions or due to their representation of needs of other species and habitats (e.g., Management Indicator Species). The following are part of the Single-species Analysis:

- ♦ Emphasis species identified including federally Threatened, Endangered, Proposed, and Candidate species; Forest Service Sensitive species; Species of Local Concern to the planning area; Management Indicator/Focal Species; and Demand species. These were selected from out of hundreds of species that rely on the Forest for habitat, including the U.S. Fish and Wildlife Service (USFWS) list of Birds of Concern to comply with the migratory bird executive order described below.
- ♦ Limiting habitat or population components and management risks for those species identified.
- ♦ Environmental consequences of the alternatives to the species and their habitats described, and the likelihood of persistence in a viability context of the at-risk and Management Indicator Species/focal species described.

This two-pronged approach evolved from policy and direction contained in many federal laws and regulations, particularly the National Forest Management Act and the Endangered Species Act. The goals of the Endangered Species Act demand a species-specific focus to prevent extinction of endangered taxa. In contrast, NFMA and its implementing regulations call for the maintenance of habitat diversity and viable populations of all native and desirable non-native vertebrate species, which is broadened by USDA Regulation 9500-04 to include viable populations of all wildlife, fish, and plants. The Ecosystem Analysis responds to limitations of the species-by-species approach and deficits in the knowledge of species requirements. It is assumed that by providing functioning ecosystems that the majority of species would remain viable. As a “safety-net” approach, species for which a concern in viability exists are analyzed to ensure adequate measures have been taken to address viability requirements of known species at risk.

The biodiversity analysis used a variety of reference materials. The Regional Office commissioned a report on the Historic Range of Variability (HRV) of the upland vegetation (Knight and Meyer 2003) as part of a Terrestrial Ecosystem Assessment (Regan

et al. 2003). An assessment of Aquatic Ecosystems was also conducted (Winters et al. 2003). Eco-regional assessments as developed by The Nature Conservancy and others were examined to help frame the Ecosystem Analysis and other aspects of the planning process. Species level information was reviewed by the Wyoming Game and Fish Department. The overall process used to assess viability, incorporating both ecosystem level and individual species level components is described in the Viability Process document in the administrative record.

The following laws, executive orders, regulations, and policies guide management of biological diversity on National Forest System (NFS) lands.

Legal and Administrative Framework

Laws

The Multiple-Use Sustained Yield Act of 1960 – “It is the policy of the Congress that the national forests are established and shall be administered for outdoor recreation, range, timber, watershed and wildlife and fish purposes... The Secretary of Agriculture is authorized and directed to develop and administer the renewable surface resources of the national forests for multiple-use and sustained yield of several products and services obtained therefrom...the achievement and maintenance in perpetuity of a high-level annual or regular periodic output of the various renewable resources of the national forests without impairment of the productivity of the land.”

The Endangered Species Act of 1973 – “The purposes of this act are to provide a means whereby the ecosystems upon which the endangered species and threatened species may be conserved, to provide a program for the conservation of such endangered species and threatened species...”

The National Forest Management Act of 1976 – “It is the policy of the Congress that all forested lands in the National Forest System shall be maintained in appropriate forest cover with species of trees, degree of stocking, rate of growth and conditions of stand designed to secure the maximum benefits of multiple use sustained yield...Plans developed ... shall ... provide for the diversity of plant and animal communities based on the suitability and capability of the specific land area in order to meet the overall multiple-use objectives, and within the multiple-use objective.”

Executive Orders

EO 11990 Protection of Wetlands – “Each agency shall...provide leadership and take action to preserve and enhance the natural and beneficial values of wetlands in ...conducting Federal activities and programs affecting land use.”

EO 13186 Protection of Migratory Birds– “Each agency shall...promote the conservation of migratory bird populations” as referenced by the Migratory Bird Treaty Act and the Bald and Golden Eagle Protection Act.

Regulations and Policies

36 CFR §219.19 (a)(5) Evaluate the effects of pest and fire management.

36 CFR §219.19 Fish and wildlife habitat shall be managed to maintain viable populations of existing native and desired non-native vertebrate species in the planning area.

36 CFR §219.26 Forest planning shall provide for diversity of plant and animal communities and tree species consistent with the overall multiple-use objectives of the planning area. For each planning alternative, the interdisciplinary team shall consider how diversity will be affected by various mixes of resource outputs and uses, including proposed management practices.

FSM 2670 Region 2 Supplement 2003-01 Forest Service direction on wildlife, fish, and sensitive plant habitat management.

USDA Regulation 9500-04 states policies of the USDA with respect to management of fish and wildlife and their habitats and prescribes specific actions to implement this policy.

Resource Protection Measures

In order to maintain biological diversity and viability, a combined approach using goals, objectives, strategies, desired conditions, management areas, and standards and guidelines has been developed. These management tools will help guide implementation of the Revised Plan. Strategies that highlight improvement of resources, such as reintroduction of beaver to improve riparian habitat, and such as strategies to reduce noxious weeds will be of paramount importance in the next planning period. The standards and guidelines, in particular, provide conservation measures for ecosystem and species habitat components. Monitoring is a part of project planning and implementation and is designed to validate the application and assumptions made in developing the plan and its components. The configuration and use of management prescriptions was also varied by alternative to provide areas where biological diversity were managed through either more active management of vegetation resources, or through more natural processes.

Abstract

Proactive improvements for biodiversity in all alternatives (except A) included the focus on larger management areas and the acknowledgement of, and planning for, larger disturbance processes that typically shape high elevation vegetation types. This is varied by alternative by focusing on mechanical methods versus more natural processes. In addition, proactive measures were added for landscape processes in terms of goals, objectives, standards and guidelines in the Revised Plan, as well as species-specific requirements largely focused in standards and guidelines. Proactive measures to be taken by management in this next planning period include the following:

- ◆ Watershed restoration (e.g., road and stream/riparian interactions).
- ◆ Travel management (road density concerns).

- ◆ Livestock administration for non-forested vegetation improvement – particularly in riparian areas.
- ◆ Aspen enhancement.
- ◆ Vegetation treatments for habitat diversity primarily in pole sized lodgepole pine stands, and other cover types such as sagebrush and ponderosa pine with missed fire cycles.
- ◆ Prevention and reduction of undesirable non-native species (vegetative and non-vegetative).

There is also the opportunity to begin use of wildland fire use. Sources for these measures included more recent scientific findings and reports. One of the most important resources for biodiversity is riparian areas, which are discussed in the Aquatics, Riparian, and Fisheries section of Chapter 3.

Ecological assessments suggest that non-native species such as noxious weeds pose one of the greatest threats to native ecosystem composition. Similarly, species composition is affected through loss of habitat, which can occur when road construction results in the permanent modification of habitat. These threats would be greatest under Alternatives A and E where increased road construction occurs; current levels of threats would likely remain constant in other alternatives. Natural disturbances (fire, insects, and disease) would continue as the largest influence on structural diversity in forested and non-forested cover types, with Alternative C having the highest potential for this, followed by B, and Alternative D-DEIS and D-FEIS. Alternatives A and E would likely have more timber harvest which would increase structural diversity in suited forested areas; however even in these alternatives natural processes would dominate the shaping of overall structural diversity. In Alternatives A and E, existing patterns of smaller openings as compared to historical disturbances would generally persist where mechanical treatments are prescribed, with this effect tapering off through Alternatives D-DEIS and D-FEIS, B, and C respectively. Research Natural Areas (RNAs) that provide areas where ecological processes are emphasized would be increased most in Alternatives B, C, and D-DEIS, followed by D-FEIS.

Regardless of alternative, several species would continue to be at risk. Aquatic species such as Yellowstone cutthroat trout and amphibians will both continued to be threatened by non-native fish. Bighorn sheep may be at risk of contracting diseases from domestic sheep. The ecology and distribution of several plant species is poorly understood, however habitat associations of sensitive plants on the Bighorn National Forest suggest risk is low. Roads are the most common development threat from management activities to individual species' habitat, with effects summarized above.

Ecosystem Analysis

The Ecosystem Analysis examines the consequences of the alternatives and their effects on the composition (covertypes) and structure (habitat structural stages, fragmentation and connectivity, snags and coarse woody debris) of systems on the Forest. Examination of the

consequences of natural and human-caused disturbance processes is an important step in evaluation of ecosystems and resulting biodiversity of the Bighorn National Forest. The Single Species Analysis follows this section.

Many aspects of the existing condition of the ecosystems of the Bighorn National Forest were described in the forestwide assessment conducted as part of the Analysis of the Management Situation (on file in the administrative record). While the affected environment and the environmental consequences presented in this section deal primarily with resources on the Bighorn National Forest, a larger spatial scale was considered in the ecological assessments reviewed (Regan et al. 2003, Winters et al. 2003) as described in the viability assessment process documents in the administrative record. In addition, interagency review and input has occurred and will continue through this process. The assessments reviewed incorporate the best knowledge and science currently available.

The Bighorn National Forest is situated within the Big Horn Mountains section in terms of ecological hierarchical classification (McNab and Avers 1994). The Big Horn Mountains section is largely an island mountain range, surrounded by basin/plains type formations. This section is further divided into subsections of three different geological/soils associations:

- ◆ Big Horn Mountains, Sedimentary Subsection (M331Ba).
- ◆ Bighorn Mountains, Granitic/gneiss Subsection (M331Bb).
- ◆ Owl Creek Mountains Subsection (M331Bc).

Additional descriptions in the forestwide assessment (on file in the administrative record) include discussions of climate and soils and their relationship to the geological formations, which further refine the ecological classification into landtypes. Landtypes and soil associations define the covertypes that occur in the Section and the Forest. The following table displays the covertypes in the Section and the proportion of those elements on the Forest.

Table 3-11. Comparison of major covertypes at the section and forest scale.

Major Covertypes	Percentage in Bighorn Mountains Section	Percentage in Bighorn National Forest*
Grass-forb	25%	18%
Shrub	16%	9%
Non-Vegetated	4%	10%
Forest	55%	63%

Source: Forest Common Vegetation Unit (CVU) vegetation GIS database, including all of the Forest and approximately 1 mile out from the boundary.

From this table, it is evident that the Forest has the bulk of the acreage for the forested covertypes in the Section. Further analysis showed that the Forest has the majority of the lodgepole pine and spruce-fir covertypes in the Section, modest amounts of the Douglas-fir type, and marginal amounts of limber pine, juniper, and ponderosa pine with regards to the overall amount in the Section by land ownership. Aspen and cottonwood covertypes occur at low amounts across the Section, and the Forest has a small fraction of the acreage for

these types based on land ownership. Where the Forest has responsibility for the majority of the coertype in the Section, the management of these resources becomes the dominant force for how these elements are maintained in the Section.

Despain (1973) described the relationship of soil types to vegetation occurrence, showing that soils largely determine the potential vegetation type. Accordingly, there are few areas on the Bighorn National Forest where forested coertypes are continually expanding into meadows in a successional pattern. There is a natural edge between meadows, forests, and other vegetation types. As shown in the previous table, the Forest has a high degree of naturally fragmented landscape, with meadows and shrub coertypes frequently interspersing forested coertypes. Strong association also exists where lodgepole pine occurs primarily on the granitic soils, while Douglas-fir, limber pine, and ponderosa pine occur on sedimentary soils. In general, the east side of the Forest is comprised of more forested areas compared to the west, and further variations of forested to un-forested are evident at the geographic area scale. Spruce-fir and aspen can occur on both types of substrates. While it is necessary to consider the activities occurring on the resources and lands surrounding the Forest for cumulative effects, information is often difficult to gather for these areas. The Historical Range of Variability assessment conducted by Knight and Meyer (2003) provided the context to assess what currently occurs versus what was thought to occur historically and is used in several of the ecosystem analysis descriptions below.

The appropriate scale for analysis was determined by the spatial extent of ecosystem elements being evaluated, or in the case of species analyses, by the movement patterns, population distribution, and other biological characteristics of specific taxa. The major elements of the ecosystem components that affect functioning of those systems and that are manipulated through management activities were selected for the analysis detailed in the following affected environment and environmental consequences sections. Cumulative effects are largely described by either the Forest or the Big Horn Mountain section and the surrounding, immediately adjacent private land. There is additional discussion in the Vegetation, Fire and Fuels, Insects and Disease, Wildlife, and Aquatics sections that provides details that are not included in the Biological Diversity section.

AFFECTED ENVIRONMENT COMPOSITION

The ecosystems of the Bighorn National Forest have a combination of forest, shrub, grass and other vegetation and non-vegetated features. The composition of the Bighorn National Forest can be described by the occurrence of dominant coertypes, including forested and non-forested types. The major vegetation coertypes occur in elevation zones which are strongly influenced by climatic and geologic effects including soils. Riparian areas cross through the various vegetation zones.

The amount and distribution of covertypes and the moisture regimes associated with them affect the occurrence of species that are dependent on the ecosystems. As the Big Horn Mountains are a geologic uplift, a strong elevation gradient shapes the arrangement of the covertypes according to the precipitation levels and soils. Refer to the map in the administrative record to view the current distribution of covertypes on the Forest that are indicative of these elevation ranges.

There has likely been little change in the overall composition of the covertypes on the Forest from a historical perspective. The amount of lodgepole (-10%) and grassland (-13%) covertypes decreased, while spruce-fir (+13%), Douglas-fir (+6%) and sagebrush (+3%) covertypes increased over the past 70 years. The increase in spruce-fir covertype and differences in other cover types may be due to a difference in inventory methods and classification, as well as the potential succession of spruce-fir from understory to overstory in some lodgepole pine stands. Aspen has likely decreased over time. Knight and Meyer (2003) concluded that the current composition of covertypes is likely within the historic range, as climate is the primary driving factor of large scale changes, and it has remained relatively constant in the last century.

The Forest covertypes that have been traditionally viewed as the most important from an ecosystem and species viability perspective are the riparian, aspen, and spruce-fir forest communities. This is due to their associated structure and moisture regimes that contribute to watershed function and provide unique habitats for the most species.

The importance of riparian areas to overall biodiversity and use by species has been well substantiated in the literature (Hawkins 1994, Thomas 1979). Riparian ecosystems cross through and occur within a number of covertypes on the Forest and include wetlands, fens, and surface waters. There is great variability in the size and complexity of riparian zones because of the many possible combinations of stream gradient, elevation, soil, aspect, topography, water quantity, and quality, type of stream bottom, and plant communities. Girard (1997) characterized 12 main vegetation groups and 53 vegetation types that can occur in riparian habitats on the Bighorn National Forest. From this aerial photo interpretation effort, approximately 104,000 acres were identified as riparian covertypes, which is approximately 10% of the total acres on the Bighorn. Riparian acres are not displayed in the previous tables. Shrublands and forests make up more than 60% of the riparian areas on the Forest. In contrast, less than 20% of the riparian areas are grass/forb dominated. The following table displays riparian covertypes on the Forest.

Table 3-12. Riparian acres for the Bighorn National Forest.

Vegetation Type	Acres and % of Total Riparian
Forested	42,288 (43%)
Shrub-dominated	18,445 (18%)
Grass and Forb	19,317 (19%)
Other	20,027 (20%)
Total Acres	100,077

Source: Bighorn National Forest Riparian GIS coverage and Girard (1997).

CHAPTER 3

AFFECTED ENVIRONMENT & ENVIRONMENTAL CONSEQUENCES

Historically, variations in riparian covertypes have occurred in response to different land uses (e.g., timber harvest and livestock grazing) and disturbance processes (e.g., flooding, fires). Historic tie hacking used streams to move products, causing an alteration in composition and geomorphology. While there have been no loss of streams on the Forest, there may have been a reduction in the amount of riparian vegetation due to lowered water tables from changes in geomorphology of stream systems (e.g., incised streambanks). Willows, the primary riparian shrub, may have been reduced through historic livestock grazing. A reduction in beaver colonies from historic levels has also affected the ecosystem functioning of riparian areas. Refer to the Aquatics section for more information on variances that have occurred. There are approximately 1,400 miles of perennial stream on NFS lands within the Bighorn National Forest. Water originating on the Forest contributes to flow in the Big Horn, Powder River, and Tongue River basins. There are also hundreds of lakes, reservoirs, and ponds distributed across the Forest, totaling approximately 6,000 acres or 0.5% of the Forest.

From a biodiversity perspective, particularly wildlife, the next most important covertypes on the Forest are spruce-fir forests and the aspen forests. Spruce-fir forests typically have a diverse stand structure due to the multiple canopies, size of trees, and amounts of coarse woody debris and snags. This is a function of the long fire return intervals, which is largely due to the moister climate and short growing season in which the forests are located. There has probably been little change historically in the amount and distribution of this coertype (Knight and Meyer 2003), though management and disturbance processes have altered the structural stages. Exceptions to this were noted above. The late-successional structure stage of this coertype is typically viewed as the most valuable for species dependent on a high number of large snags and large amounts of coarse woody debris. Well-developed soil horizons in this type support a diversity of organisms. Lodgepole pine is the most dominant coertype on the Forest, though some lodgepole pine is seral to spruce-fir (Hoffman and Alexander 1976, Jones and Ogle 2000). Approximately half of the 385,000 acres of lodgepole pine on the Forest may be seral, indicating some fluctuation over time in the amount of spruce-fir in response to disturbance processes, succession, or vegetation management practices.

There are approximately 9,400 acres (less than 1% of the Forest acres) of aspen on the Forest. Aspen represents the only ‘upland’ deciduous forest type in the mountain range. As such, it provides habitat for plants, insects, and animals not provided by other forest types. Aspen provides an abundance of forage for many species due to the moister sites it typically occupies, its quick growth, and its higher-than-average number of snags and cavities for some species due to the amount of diseases and pathogens associated with the coertype. A greater diversity of understory vegetation also contributes to the biodiversity value of aspen. Aspen have been noted to be in decline in many areas of the West from the following factors:

- ◆ Conifer succession from reduced fire frequency as a consequence of active fire suppression and a lack of fine fuels available from livestock grazing.
- ◆ Possible climate changes.

- ♦ High levels of ungulate browsing suppressing regeneration (Bartos and Campbell 1998).

Aspen on the Forest occurs on different sites as a climax or as a successional part of the landscape, depending on soils and surrounding vegetation. It is not clear if any aspen has been “lost” on the Bighorn National Forest, however there are many areas where conifer succession is taking place and areas where ungulate browsing is retarding regeneration and productivity of sites (Knight and Meyer 2003). Aspen have been a focus of management effort for the past few decades, though the amount of treatments has not been enough to cause widespread changes in the current condition of the covertime on the landscape; there is still a lack of young aspen stands on the Forest.

Other habitat types of interest in the Big Horn Mountains include alpine meadows, cliffs, and caves. Alpine meadows support a diversity of plants and associated pollinators despite a short growing season. This covertime may be undergoing some loss due to the amount of recreation use in the wilderness, among other factors. Cliffs and caves are a function of the geological formations and provide for unique habitats for associated plant or animal species. Cliffs and caves are largely unchanged from historical conditions, though recreation use has altered some, such as a reduction of use by bats in highly visited caves, or potential rock climbing disturbance at some popular cliff sites. Under the definitions in the 1988 Cave Management Act, four “significant” caves have been designated on the Forest, all on the Tongue Ranger District. Several other caves on the Forest may provide habitat for bats and may be considered significant but have not been evaluated. No gating or other restrictive management actions are in place for these caves. Cliffs are important for nesting raptors and some rare plant species that can be sensitive to recreation disturbance including rock climbing, which is currently a minor use.

Current threats to covertypes include introduction of non-native species (e.g., white-pine blister rust and noxious weeds) and loss of covertypes through development (e.g. roads). Non-native agents change the native composition of the covertypes beyond what has taken place historically. Refer to the Insects and Disease, and Noxious Weeds sections for more information on this subject. Most of the limber pine will have been killed from the white pine blister rust in the next two decades. White-pine seeds are large and are important foods for many species. Therefore, loss of this 5-needle pine will impact some wildlife species. In the Terrestrial Assessment (Regan et al. 2003), road and urban development patterns were evaluated against covertypes. Aspen and willow (riparian) covertypes contain a high percentage of travel routes.

Ecosystem processes and composition may also be influenced by changes in plant and animal species that shape the systems and disturbance processes. The introduction of non-native fish species affects the ecological functions and composition of aquatic ecosystems. The current lack of beaver also affects runoff and disturbance processes in aquatic ecosystems. The lack of certain extirpated large predators such as wolves and grizzly bears may be influencing upland ecological functions.

Thousands of species are tied to the habitat features described above, including plants and animals, both terrestrial and aquatic. Due to the interspersed of many different habitat

features, the Forest provides a unique setting for many species found within the Rocky Mountains, Great Plains, and Great Basin ecotypes. No single species unique only to the Big Horn Mountains has been identified, though unique subspecies occur due to the isolated geography of the Big Horns.

ENVIRONMENTAL CONSEQUENCES COMPOSITION

Direct and Indirect Effects

In considering direct and indirect effects to resources resulting from Forest Service management activities, only those activities with the potential to cause a measurable or substantial change are described. For example, minerals and special use activities are not anticipated to have a substantial affect on the vegetation composition of the Forest because these activities are a minor component of overall management activities on the Forest and they are not expected to increase during the planning period.

Under all alternatives, climatic and biological processes will continue to be the dominant influence the composition of the Bighorn National Forest. The occurrences of the major covertypes are relatively constant over historic time frames. The current abundance and distribution of major covertypes and vegetation composition are generally similar to the common patterns over historic periods within HRV (Meyer and Knight 2003), with noted exceptions where noxious weeds or other non-native species (e.g., blister rust) have altered it. Composition changes following disturbances can last for varying amounts of time depending upon the severity of the disturbance. For example, severe wildfire disturbances, insect and disease, or blowdown in spruce-fir ecosystems can change composition for hundreds of years following the disturbance, though eventually a spruce-fir stand will be reestablished. Other types of disturbances create composition changes that last only for a few years. Refer to the Wildfire and Insect and Disease sections in this chapter for more information. The following management activities have the potential to introduce or increase spread of noxious weeds, which are the most likely element to cause a more permanent change in species composition of vegetation types currently on the Forest.

Effects from Livestock Grazing: Grazing by both livestock and wildlife is a disturbance agent to the herbaceous cover. Grazing effects on composition depend on a number of factors, including the amount of grazing, timing, seral stage of the area, and other environmental parameters. Most changes to composition on the Forest, including the expansion of Kentucky bluegrass in riparian areas, noxious weeds, and other effects associated with livestock grazing have occurred from higher stocking rates of livestock in the past. Grazing retards the growth of herbaceous and woody cover if done in excess, and thereby slows progression of seral stages following disturbances. Trampling can also

disturb soil or impact plant growth. Most effects from livestock grazing are evident in riparian areas and, to a lesser extent, in meadows and aspen sites.

There will be few changes in the composition or the amount of riparian areas. The composition of vegetation within riparian areas will trend towards species and life forms (trees and large shrubs) associated with later successional stages. Standards and guidelines limit activities adjacent to riparian areas and wetlands, including amount of livestock use. Changes have been made in forestwide direction to address cumulative effects of livestock and wildlife grazing to plant species composition; desired vegetation conditions are addressed at the site-specific or project level. The effects of livestock grazing on vegetative composition does not vary by alternative because livestock grazing does not vary by alternative. Grazing conducted according to forest plan direction should result in a positive change in vegetative composition from past conditions as riparian areas re-establish in certain areas and composition tends toward later successional stages. For a description of past, current, and future livestock grazing levels, refer to the Livestock Grazing section in this chapter; for additional vegetative effects, refer to the Rangeland Vegetation section.

Effects from Timber Harvest and Fire Management: Timber harvesting and/or prescribed fire can emulate natural disturbances in that they change or remove the dominant vegetation and provide for the growth or establishment of other vegetation. Overall, there are no long-term changes to composition as regeneration occurs and matches pre-existing composition. The amount of vegetation manipulated through timber harvest varies by alternative, as described in the following discussion of habitat structural stages.

The largest effect to composition would be from natural disturbances including fire, insects, disease, and blowdown. These disturbances would affect all vegetation types by restarting seral progression. For forested vegetation types, refer to the habitat structural stage discussion below. Prescribed fire would continue to be conducted primarily in shrub covertypes. In non-forested vegetation types, many plant species are adapted to fire occurrence and would thrive from the effects of fire. Other species would need time to reestablish. Under Alternatives B and C, more land would be managed with wildland and prescribed fire as the primary disturbance agents. Alternatives D-DEIS and D-FEIS would be similar to existing levels of this type of management, and Alternatives A and E would have the least amount of this type of management and more commercial timber harvest to manipulate forested vegetation. In the past, harvested areas were sometimes revegetated with species not present originally. This practice is no longer used. Timber harvest areas are now planted with the tree species that occur on the site naturally. There are minor amounts of tree injury due to harvesting practices that allow the spread of some diseases among trees, however this amount is negligible at the forestwide scale due to the few acres harvested each year, and has not been shown to cause the spread of any non-native diseases that would affect composition.

Aspen management would be emphasized in all alternatives. However, due to past funding history and priorities, and expense involved in protecting aspen from browsing, it is unlikely enough aspen would be treated with regeneration treatments to counteract

maturing forest conditions. Fifty acres per year may be treated with regeneration harvests (e.g., canopy thinning, conifer removal, and clone fencing) over the next planning period in Alternative D-FEIS, versus 10 or 20 acres likely in Alternatives A, C, or B, D-DEIS, and E. This is considerably less than the 150 acres per year needed to maintain aspen on the Forest in a more balanced age class distribution, based on acres and rotation age. Limited road networks may limit treatment of this resource as costs rise considerably when access is difficult. Livestock and wildlife browsing impacts would continue to be addressed through small site-specific projects. Wildfires and prescribed fires may help regenerate stands and control succession in some instances, though there may be insufficient fine fuels in aspen stands to carry fires. For the next planning period, management emphasis (other than regeneration treatments) will likely focus on removing conifer encroachment. Up to several hundred acres per year could be treated with this practice. Herbivory impacts would likely continue to retard aspen regeneration. In addition, both harvesting activities and fire management activities can provide conditions for the establishment or expansion of undesirable or non-native vegetation

Effects from Recreation and Travel Management: Roads and trails change vegetation composition by removing existing vegetation and altering soil structure. For a description of existing and future road and trail networks and densities, refer to the travel management section of Chapter 3, and to the connectivity/fragmentation discussion below. Roads have been constructed primarily to harvest timber on the Forest. They are generally constructed in the less steep terrain and in open covertypes (sage, grass) when possible due to ease and cost of construction. Hiking trails largely follow riparian areas, are narrow (2' wide), and are typically constructed for recreation purposes. Less than 3 miles of new hiking trail are anticipated in the next planning period, while most trail maintenance will involve reconstruction or other activities. There would be anticipated reductions in overall road densities in Alternatives B and C and increased levels of road densities in Alternatives A and E. If Piney and Rock Creek areas are roaded in Alternative A and E, this would significantly increase road densities. Road densities in both Alternative D-DEIS and D-FEIS would remain similar to current levels, with small increases. Approximately four miles of road per year would be decommissioned under all alternatives, allowing some areas to regenerate to pre-existing covertypes, although decommissioning is currently largely focussed on user-created routes which do not reduce the Forest system route density. Where new roads cross streams, there will be some disruption or loss of aquatic vegetation and function. The required use of best management practices limits the effects of stream crossings from recreation and travel management.

Alternatives E and A would likely have some impacts to spruce-fir due to timber harvest activity. These alternatives would have the most potential impacts on riparian (increased road crossings) and likely minimal, if any, impacts to aspen. However, none of the impacts would likely cause a loss or decline of the cover types. The total miles of road and acre equivalents of anticipated road development by alternative are displayed in the table below. Approximately 90% of these roads would be closed following construction and use. However, some loss of vegetation communities would occur associated with the acreage impacts. The acre figure estimated was from an assumed 16-foot road prism.

Under Alternatives A and E, primary access roads into the Piney/Rock Cr. areas would remain open for motorized vehicle travel for the purposes of this analysis. This would represent a substantial change over current conditions. The roads considered in this analysis are forestwide estimates derived from timber modeling, with inherent assumptions. This analysis does not include temporary roads built within harvest units that typically revegetate well.

Table 3-13. Anticipated road construction for the Bighorn National Forest by alternative for the first decade.

Alternative	Miles of Road/Acres
E	21 miles / 41 acres
A	17 miles / 33 acres
D-DEIS	12 miles / 23 acres
B	8 miles / 16 acres
D-FEIS	6 miles / 12 acres
C	4 miles / 8 acres

In addition to management-created roads, roads created by recreationists continue to be of concern. These user-created roads do not typically affect composition as much as system roads, as they tend to be limited to tire tracks, though watershed effects (e.g., erosion and sedimentation) also accompany these roads. An effect that is directly proportional in relative magnitude to the amount of road construction anticipated in the table is that people and vehicles on open motorized routes are a vector for spreading invasive species (e.g., noxious weeds).

In addition to roads, dispersed recreation campsites affect composition by removing vegetation on the site; sites are typically in riparian areas or in meadows on the edge of timber stands. This type of use would probably increase, though new emphasis on managing these types of sites applies to all alternatives. This problem occurs in both wilderness areas and in motorized recreation areas, so there would be no likely differences among alternatives. Developed sites (campgrounds, lodges, summer cabins, etc.) have also caused a loss of habitat or a change in original composition, though there is no increase in this type of activity anticipated in the next planning period. In addition, there can be effects to vegetation resources from winter motorized recreation activities. A summary of this information occurs in the Wildlife section of Chapter 3, but also applies to vegetation resources.

With regard to caves, recreational activity would continue, possibly impacting some caves, though there would be no “loss” of caves. However, development and implementation of management plans for these resources has also been identified as a strategy in the Revised Plan. Where significant damage or safety considerations exist, some caves may have restricted access applied. Caves serve an important role in providing habitat for rare bats and other species. Of typical concern for caves are the effects of above-ground activities, including road construction and vegetation management (grazing, fire, timber harvest,

etc.). As most of the cave resources are located on the steep faces near the Forest boundary, there are few, if any, above ground activities anticipated for these areas that would have the potential to affect these resources, though plan direction was included to address this potential in projects. It is assumed that vegetation management largely mimics what would occur naturally, but road construction would not. As discussed above, there would be more potential for additional roads in Alternatives A and E as compared to other alternatives.

Cumulative Effects

The analysis area for cumulative effects to biodiversity composition would include the Bighorn National Forest and the land immediately adjacent to it within approximately 3 miles. Trends applied to the larger Big Horn Mountains ecosection are noted below (limber pine). Cumulative effects include past, present, and reasonably foreseeable (planning period) projects, as mentioned in the summary of activities table in the introduction to Chapter 3. The time period into the future considered would be the planning period (10-20 years). From this table, refer to the past and present activities of vegetation management and roads, and the reasonably foreseeable future activities of subdivisions, highway widening, and increased recreation use (OHV, demographics) for the most significant effects to ecosystem composition. In considering the direct and indirect effects described above, the following table presents a summary of how the alternatives are anticipated to cumulatively affect ecosystem composition.

Table 3-14. Relative impact of alternatives on the ecosystem composition resource.

Land Use Category		Less Impact ← Relative Impact → More Impact to composition				
Effects from land authorizations		No difference between alternatives				
Effects from motorized recreation mgmt. (potential for user created roads and increased dispersed recreation use associated with anticipated road construction)	C	D-FEIS	B	D-DEIS	A	E
Effects from livestock grazing (noxious weed increase)		No difference between alternatives				
Effects from timber harvesting (tie to suited acres and loss of composition from roads, stream crossings, and potential increase in noxious weeds)	C	B	D-DEIS	D-FEIS	A	E
Effects from utility corridors and additional development of land		No difference between alternatives				
Land available for locatable minerals and oil and gas	C	B	D-DEIS	D-FEIS	A	E

Noxious weeds and non-native vegetation (e.g., cheatgrass) would also likely continue to expand on lands adjacent to the Forest and private lands within the Forest due to lack of

treatment. Expanding subdivisions adjacent to the Forest also provide a loss of composition and habitat, and opportunities for weeds. Livestock grazing, particularly in riparian areas, would further create opportunities for noxious weeds. This could create larger seed sources and opportunities for expansion onto the Forest. Dispersal vectors of most significance include roads, recreation use, livestock, and wildlife. Loss of vegetation composition could also result in loss of species such as pollinators and other wildlife tied to the affected vegetation. The Forest developed a 5-Year Action Plan to implement Revised Plan direction (similar in all alternatives) to reduce the potential for expanding noxious weeds and the loss of ecosystem composition elements associated with them.

Other than planned expansion of the U.S. Highway 14 corridor above Dayton, there are no additional losses of composition due to highways anticipated. It is likely that road densities adjacent to the Forest would continue to increase through urban development or other resource uses, making the integrity of the vegetation composition on the Forest more valuable.

The loss of extensive acres of limber pine is expected to continue because of the non-native white pine blister rust. While the Forest is collecting seed from resistant trees, it is expected that 90% of the limber pine will be killed from the rust within the next 2 decades. Trends of this effect would be similar for the lands adjacent to the Forest, and for the entire Big Horn Mountains ecosection. This effect would continue without regard to plan alternatives.

Aside from noxious weed impacts and any potential additional road crossings described above, riparian areas would likely continue to improve in quality in terms of vegetative composition and structure over time. This is primarily related to the application of livestock grazing standards and guidelines, and other forestwide direction listed in the riparian section of Chapter 1 of the Revised Plan. Improvements in riparian areas have been demonstrated for at least the past decade on the Forest at the project scale in terms of both improved livestock administration and in terms of watershed improvement projects. Riparian areas off the Forest may degrade in comparison to the Forest through urban development or other land uses, placing a higher value on this type on the Forest. The Forest also has the bulk of the montane riparian component of the Big Horn Mountain ecosection, indicating trends on the Forest would affect or represent the larger area. These effects would occur similarly for all alternatives.

Effects of water depletion on riparian system function and vegetative composition may increase if municipalities request additional reservoirs or diversions. However, many municipalities are also utilizing wells drilled off the Forest for their water needs. There would not likely be any additional depletion from the Forest attributable to agricultural diversions or facilities needs on the Forest. Refer to the Aquatics section of this chapter for further discussions on aquatics and riparian impacts.

Together, the past, present, and future uses associated with the alternatives and the adjacent land impacts indicate an increased value in the less developed condition of the Forest in terms of retaining composition elements. This would favor the alternatives that call for less active management in terms of road related disturbances, favoring Alternative C, then

B, then D-FEIS, D-DEIS, A, and then E. There is very little likelihood of additional disturbances on the Forest such as new campgrounds, lodges, administrative sites, or other developments that would create a loss of habitat. In considering the above cumulative effects, there is some risk to biodiversity from a reduction in composition (weeds, limber pine, etc.), however the impacts in the next planning period are estimated to be localized from weeds rather than widespread, and it is anticipated that some rust-resistant limber pine may also emerge over time. It is estimated that existing natural processes will allow the composition elements to continue to function across all alternatives.

AFFECTED ENVIRONMENT HABITAT STRUCTURE STAGES

Forested ecosystem elements are created and maintained through the interplay of succession and disturbance. Succession is a process of biotic community development that involves changes in species composition, structure, and community processes over time. Succession is reasonably directional and, therefore, predictable (Schwarz et al. 1976). Forested stands develop recognizable stand structures over time. This structure can be described in terms of the horizontal and vertical distribution of components including height, diameter, crown layers, and stems of trees, shrubs, herbaceous understory, snags, and down woody pieces (Thomas 1979). At broader spatial scales, disturbance and succession along with edaphic features lead to structural pattern represented by patches, and patch boundaries.

Different arrangements of these components provide different habitat for wildlife (Edgerton and Thomas 1978, De Vos and Mosby 1971). Combinations of these components were identified as habitat structural stages (HSS) for forest covertypes by Hoover and Willis (1987), and range from HSS 1 (grass/forb) to HSS 5 (old growth). The following table describes the characteristics of HSS; HSS 5 is discussed separately below.

Table 3-15. Habitat structural stage definitions, Hoover and Wills (1987).

Habitat Structural Stage	Description	Diameter	Crown Cover %
1	Grass/Forb	Not applicable	0-10%
2	Seedling/Sapling	< 1 inch	10-100%
3A	Pole Sized	1 – 9 inches	10-40%
3B	"	1 – 9 inches	40-70%
3C	"	1 – 9 inches	70-100%
4A	Mature Timber	9+ inches	10-40%
4B	"	9+ inches	40-70%
4C	"	9+ inches	70-100%

It is important to recognize that structural stages represent succession in forested stands only; the grass/forb, structural stage 1, refers only to forested stands that have undergone a stand-replacing event and are temporarily in a “non-forested” condition. Structural stage 1 does not include naturally occurring meadows, nor does structural stage 2 include naturally occurring shrublands. Though the Forest’s CVU database assigns structural stages to grass and shrub vegetation types, the areas where this is a successional stage to future timber types carry a “T” (timber) designator.

The Bighorn National Forest is dominated by the HSS 3 size classes. This is primarily due to fires in the latter part of the 1800s and to a lesser extent timber harvest in the 1960s. At some sites, the burned areas have stagnated at pole-size (5-9” diameter) stands; the harvested areas have regenerated in sapling size (1-5” diameter) stands. Structural stages also vary geographically. In the Piney/Rock Creek area, past fires have resulted in almost entirely pole sized stands (HSS 3); in Shell Canyon approximately 60% of the stands are in a mature (HSS 4) condition. There are also differences among covertypes; for example, lodgepole pine and Douglas-fir stands have a high proportion of HSS 3 compared to spruce-fir. Lodgepole pine is a fire-adapted species which often regenerates in densely stocked stands following disturbance. Many of these stands become stagnated at the pole size and are regenerated by another disturbance prior to reaching more mature stages. For additional discussion of structural stage distributions by covertype and by geographic area, please refer to the forestwide and geographic area assessments completed for the plan revision and the administrative record, and Chapter 3 of the Revised Plan. The following table describes the distribution of structural stages by covertype at the forestwide scale. Early, intermediate, and mature stages represent the totals of those stages above them as a percent of the total acres.

Table 3-16. Acres in each HSS by covertype for Bighorn National Forest (2002).

HSS	Spruce-fir	Lodgepole pine	Douglas-fir	Ponderosa pine	Aspen
1	0	4,260	0	0	0
2	2,015	9,023	188	0	119
Early	1%	4%	0%	0%	1%
3a	27,091	13,173	7,149	1,060	1,892
3b	49,840	78,178	22,674	5,636	3,406
3c	4,7848	157,432	30,377	4,053	529
Intermediate	53%	71%	60%	57%	62%
4a	8,601	4,292	2,388	1,118	1,163
4b	37,352	30,954	12,270	4,768	1,817
4c	62,007	53,008	25,249	2,074	474
Mature	46%	25%	40%	43%	37%
Total Acres	234,754	350,320	100,295	18,709	9,400

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The 1985 Forest Plan had direction to maintain 5% of Diversity Units (approximately 5,000-acre areas) in the grass/forb structure stage (HSS1) and 5% in the old growth stage. While the Forest is likely meeting this past old-growth direction, it is not meeting the early seral condition direction. Maintaining significant components of both types is an important element of planning for biodiversity.

There are no lands currently defined as HSS 5 (late-successional/old growth) in the Forest's CVU database. The failure to classify stands as HSS 5 results from the difficulty in classifying old forest through aerial photo interpretation. However, documentation on the amount and distribution of late-successional forested stands (HSS 5) were prepared as part of the forestwide assessment. This documentation also addresses future management recommendations (see the administrative record for a more complete discussion). There has been a limited amount of inventory to determine the amount and distribution of old growth on the Forest. Inventory has largely been completed in the Clear/Crazy and Tensleep geographic areas, with the Goose Creek geographic area scheduled for 2005. On a forestwide perspective, available data comes from stand exam (inventory) data on approximately 40% of the forested acres. Old growth inventories (scorecards) have only been conducted in small project areas in response to desired vegetative treatments, the exception being the Clear/Crazy effort. From stand origin dates (when the stand was regenerated) and current knowledge of 4C structural stages in roadless areas where timber harvest has not occurred, it is estimated that approximately 10-15% of all the forested acres on the Bighorn National Forest would currently qualify as old-growth. The following table displays the description of old growth by coertype. Some coertypes (limber pine, juniper, and cottonwood) were not described due to their low occurrence on the Bighorn National Forest, historically and presently, and lack of management in these types.

Table 3-17. Old growth descriptions by coertypes.

Coertype	Age of Largest Trees	DBH of largest trees	Crown Cover %
Lodgepole	150	10 tpa > 10 inches	≥ 1 canopy layer
Spruce-Fir	200	10 tpa > 16 inches	>1 canopy layer
Ponderosa Pine	200	10 tpa > 16 inches	≥ 1 canopy layer
Douglas-fir	200	10 tpa > 18 inches	≥ 1 canopy layer >50% cover
Aspen	100	20 tpa > 14 inches	≥ 1 canopy layer >50% cover

Tpa - trees per acre, from (Mehl 1992)

Characteristics of late-successional stands vary according to the coertype as described in Mehl (1992). For example, late-successional conditions in ponderosa pine stands involve large trees in an open, park-like setting, while the same stage in spruce-fir involves large and small trees in a multi-canopied overstory and a diverse understory. One challenge in using habitat structural stages to describe forests is that there are no provisions for multiple

canopy layers or numerous age classes within the same stand of trees (Hoover and Wills 1987).

Spruce-fir forests typically occupy higher elevations and wetter zones, causing a longer disturbance interval and allowing stands to reach a mature and old growth condition more readily than some lodgepole pine stands. However, most of the spruce-fir and higher elevation lodgepole pine types are in a mature condition. This may indicate a lack of younger structural stages, though the covertypes are still within natural ranges due to the long fire return intervals. The current amount and distribution of structural stages has been the result of disturbance processes, namely the combination of wind, insects and disease, and wildfire. From the late 1800s to the early 1900s, widespread fires changed the forested landscape.

Ponderosa pine occurs primarily at lower elevations around the edge of the Forest boundary. Most of the ponderosa pine is in mature structure stages with dense understories as a result of fire suppression for the past century. Douglas-fir occurs at higher elevations than ponderosa pine and is similarly characterized by an abundance of mature conditions with dense understories. While also a result of fire suppression, the structure of Douglas-fir is generally not out of HRV (current condition is not significantly different than conditions common in the past), due to a more mixed fire return interval. Aspen is not abundant on the Forest and typically occurs on more mesic soils at mid-elevations. It is also represented by an abundance of HSS 4. Limber pine, juniper, and cottonwood were not displayed due to their lack of abundance on the Forest. Refer to the administrative record to view the current distributions of structural stages by coertype on the Forest.

Disturbance Processes Affecting Structural Stages

Ecosystem processes are most influenced by the availability of water, in terms of both soil moisture and what is available in the atmosphere and in surface water. Disturbance processes such as fire, insects, and disease often fluctuate in response to water availability. Water is not evenly distributed on the Forest. High elevations are generally wetter than lower elevations. The “rain shadow” effect from high peaks also influences available moisture. This distribution of water influences the spatial pattern of aquatic and riparian ecosystems and influences soil types and associated vegetation covertypes.

Succession is slow in Rocky Mountain coniferous forests because of the short, cool growing season (Knight 1994). Decomposition is also limited by the cool and sometimes dry climate (Knight 1994). As much decomposition can occur under the snow as during the summer (Fahey 1983). Forest level growth, nutrient cycling, and decomposition processes have also been modified by land uses or disturbances.

The main disturbance processes of fire, insects, and disease affect all vegetation covertypes on the Forest creating changes in composition and structure stages, but these changes are obvious and attract management attention in the forested covertypes. Blowdown typically only affects forested vegetation and affects much fewer acres than fire, insects, and disease.

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Fire is the most significant natural disturbance agent in high-elevation forests of the Rocky Mountains. Wildfire has been an important influence on the patch size and landscape structure, density, species composition and age of non-forested and forested vegetation throughout the Bighorn National Forest. Meyer and Knight (2003) report that “At higher elevation, fires were less frequent and the stands had a mixed fire regime, with both ground fire and stand-replacing fire occurring in the past; the structure and fire pattern of this forest is probably consistent with historic forests.” The role that fire plays in an ecosystem is summarized by fire regime descriptions as described in the Fire and Fuels section of this chapter. Stand-replacing fires may be small or widespread in extent on the Bighorn National Forest. With the exception of ponderosa pine, juniper and Douglas-fir forests, fire suppression has not currently altered fire return intervals, as long intervals are typical for higher elevation forests that comprise the majority of the Bighorn National Forest. As more low-elevation forested types occur in the remainder of the Big Horn Mountains ecosection, fire suppression has likely had a larger effect on altering historic patterns of structural stages and coverytype composition than compared to the Forest.

Insects and disease are widespread over the Forest. Refer to the Insects and Disease section for further information. Bark beetles can act as a stand replacement process similar to fire, but frequently occur at low levels that affect small groups of trees and influence within-stand structure more than landscape structure. Changes in stand composition and structure can be changed relatively rapidly by insect attacks.

Native diseases mostly operate at the stand level and influence growth and structure of individual trees. Dwarf mistletoe and Comandra blister rust are noted for reducing tree growth and ultimately the supply of forest products but also provides wildlife habitat structure not found in areas without mistletoe. Native disease works more slowly than insects and may take decades to change forest stand composition or structure. Non-native diseases such as white pine blister rust work much faster and have much more impact on the native species.

Engelmann spruce is affected primarily by spruce beetle (*Dendroctonus rufipennis*). Lodgepole pine is affected primarily by the mountain pine beetle (*Dendroctonus ponderosae*), Comandra blister runs, and dwarf mistletoe (parasitic plants). Armillaria root disease has been observed on lodgepole pine, ponderosa pine, and subalpine fir, but is of minor concern on the Forest. Comandra blister rust has also been observed on ponderosa pine but is of minor concern. Western balsam bark beetle primarily affects subalpine fir. Aspen decline is due to a complex of lack of disturbance, fire suppression, and replacement by other later successional species.

Blowdown extent and patterns are influenced more by topography and duration of wind events. Blowdowns have occurred in the recent past, including 1991, 1993, and 1997 where a combined total of approximately 4,000 acres of mature timber were blown over. This scale of wind incident is historically rare on the Forest. Smaller events are more common. Some of the blowdown in forested stands are associated with the edges of timber harvest units or fires, where wind patterns have been changed by the removal of trees. Blowdown may also result in increased levels of insect and disease elements.

Timber harvest activities have occurred in approximately 18% of the forested acres on the Forest, though only approximately 3% of the forested acres have been treated with clearcuts (Regan et al. 2003). Harvest systems other than clearcut do not affect structural stage distributions nearly as readily.

Alterations in stand structure affect habitat for plant and wildlife species. Some species are adapted to an open structure for at least part of their life cycle. Some animal species need a long line of sight for successful hunting; some rely on plants that need a sunny or open understory. Other species need large trees and snags in dense canopies for nest sites and winter roosts, or shaded growth conditions for certain plants. Some animals may use a combination of open forest for foraging and dense patches for nesting in close proximity.

ENVIRONMENTAL CONSEQUENCES HABITAT STRUCTURE STAGES

Direct and Indirect Effects

Vegetation patterns across large spatial scales result from complex interactions between biotic and abiotic disturbances, processes, and constraints. It can be difficult to project the combined effects of these complex interactions over long periods of time due to the assumptions involved. For planning purposes, vegetation modeling did not include these more random and highly variable factors that will inevitably occur. Only management induced changes resulting from mechanical harvest were modeled. However, these natural disturbance processes will continue to affect large areas throughout the next planning period, regardless of management prescription emphasis. Even though mechanical harvest may reduce fuel loadings in some prescriptions, fires and insects and disease will likely occur at increasing levels given the current age of the forested areas.

For each alternative, modeling was conducted to describe the likely projection of habitat structural stages over time. Projecting changes in vegetation structure and composition over time is an important part of predicting the environmental consequences of changes in the occurrence and distribution of ecosystem aggregates and in the maintenance of biological diversity from management area allocations. The contractor providing the information used the Woodstock© model, which allows for growth and yield components of forested stands to be tracked spatially as one possible solution. Actual site-specific project implementation will likely be more detailed and may be different than the solution the model predicted. The existing CVU GIS database was used as a baseline for this modeling effort. Constraints were applied to the model to reflect forestwide standards and guidelines, as well as management area prescriptions and their corresponding emphasis. For determining availability of commercial timber products, only those acres suited for timber production (see glossary) within management prescriptions 5.11, 5.12, 5.13, 5.4,

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and 5.5 were included. Refer to the administrative record and FEIS Appendix B for additional details on this modeling.

There are no anticipated effects from minerals management, special uses or other programs on the Forest other than those listed.

Effects from Timber Harvest: Timber harvest can directly alter the structural stage of forested coetypes, either in density, size class, or canopy cover. Several harvest methods are available to achieve silvicultural objectives, producing different effects. Uneven-aged systems maintain a forested canopy. Even-aged systems such as shelterwood retain some of the canopy longer. Clearcut harvests create an immediate change to structural stage 1. Refer to the Vegetation and Timber sections in this chapter for further information. Final harvests conducted for timber production objectives on suited timber lands are designed with an assurance of regeneration within 5 years. This successful regeneration maintains coetypes and initiates the flow of successional stages over time. Different management scenarios emphasize or allow retaining forest structural elements within regenerated stands.

The following table illustrates the anticipated habitat structural stage distribution by alternative that is anticipated in conjunction with timber harvest at the 10-year and 50-year horizons. Modeling was conducted up to 150 years to ensure long term sustained yield of the suited timber component, which all alternatives met. Model results are only from predicted timber harvest, and do not include changes in structural stages that are possible from natural disturbances. Spatially, management changes would mostly occur where suited lands are designated. As forests mature, levels of insects and disease and fire would likely become the major agents of change resulting in changes in structural stages. Refer to the Fire and Fuels and Insects and Disease section for estimates of this type of activity. Model results are compiled for all forested acres. For more details on acres of structural stages by coetype (e.g., lodgepole, spruce/fir, ponderosa) or geographic area, refer to the administrative record. In the table, the early stage includes HSS 1 and 2, the intermediate stage includes HSS 3A-C, and the late stage includes HSS 4A-C and 5. Total forested acres used in the model were approximately 724,500. Variations across alternatives are due largely to harvest method and acres of suitable timber as described in the timber products and forested vegetation sections within this chapter. Refer to the Timber section in this chapter for anticipated HSS on suited lands.

Table 3-18. Acres of habitat structural stage by alternative at 10- and 50-year periods.

HSS	Alt A	Alt B	Alt C	Alt D-DEIS	Alt D-FEIS	Alt E
Early (1 and 2) 10 years 50 Years	67,736 8% of total forested acres	60,593 7%	56,959 7%	62,981 8%	63,654 8%	69,327 9%
	20,245 2%	8,198 1%	4,503 1%	10,532 1%	10,142 1%	20,108 2%
Intermediate (3A-C)	402,213	407,060	409,600	405,449	406,396	402,089

HSS	Alt A	Alt B	Alt C	Alt D-DEIS	Alt D-FEIS	Alt E
10 yrs.	50%	50%	50%	50%	50%	50%
50 Years	301,333 37%	305,137 38%	303,818 38%	305,581 38%	306,299 38%	302,862 38%
Late (4A-C)	131,023 42%	133,616 42%	134,774 43%	132,758 42%	133,640 42%	129,668 42%
10 Years						
50 years	280,678 35%	289,210 35%	294,281 36%	286,347 35%	287,207 35%	279,386 34%
Old Growth (5) 10 Years	210,784 26%	210,795 26%	210,786 26%	210,775 26%	210,778 26%	210,810 26%
50 Years	210,784 26%	210,795 26%	210,786 26%	210,775 26%	210,778 26%	210,810 26%

Under all alternatives, model results indicate that without fire or other natural disturbances, there will be very little change from current conditions as a result of timber harvest activities at the forestwide scale.

In Alternatives A and E, there is some risk of not retaining enough old growth due to increased levels of harvest should natural disturbances create additional losses of old growth. However even under Alternatives A and E, less than 30% of the total forested acres is suited for timber production. Modeling of potential harvest levels included the old growth parameters. Under all alternatives, the model indicated that the lack of timber harvest activity would result in an increase in the amount of habitat structure stages 4A-5. The increase is less pronounced under Alternatives A and E; however, under all alternatives it may be difficult to meet or maintain younger seral stages from harvest on suited lands alone.

In some areas, timber harvest and the resulting changes in habitat structural stage may improve resiliency to natural disturbances. For example, where timber harvest is employed, wildfire severity may be reduced due to less fuel loading. However, with fire this could be a double edged sword. Experience on the Forest has shown that roads constructed for timber harvest may provide additional fire starts from recreational use. Roads do not always provide barriers to fire spread during intense stand-replacing fires due to spotting potentials of forested covertypes, and the high wind usually associated with larger fires. Roads do improve firefighter access so that any fires caused by increased human use are typically kept small.

Effects from Disturbance Processes (Fire, Insects and Disease, Blowdown): For all alternatives, the combination of wildfire, insects and disease, and blowdown would continue to be the most significant disturbance events influencing changes of forested covertypes and causing differences in habitat structure stages. These largely random events were not included in this effects analysis modeling conducted as part of the plan

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revision. However, fire probability modeling indicates a 18% chance of fires consuming more than 15,000 acres total on the Forest in the next 10 years, based on known fire occurrences since the early 1900s. This could be in addition to insect and disease outbreaks and blowdown, though they are often interrelated.

Wildfire would likely be more extensive in alternatives emphasizing natural processes, such as C and B. Wildfires and insects are both influenced by stand structure and drought. Since many of the existing forest stands originated between 100-150 years ago, there is potential for large-scale events over large areas of the forest during extreme climatic conditions (Brown et al. 1999, Romme and Knight 1981, Veblen et al. 2000).

Alternatives A and E have the greatest number of acres where direct fire suppression would be used and where insect and diseases could be managed. Conversely, Alternatives C and B would have more acres where fires are allowed to burn to accomplish resource objectives. Similar suppression efforts for insects and disease would accompany the fire suppression efforts, as stands managed for commercial timber products would have active management against these agents. There would be a difference in resilience or treatment of blowdown with Alternatives C and B having more acres where natural processes are the dominant force, and salvage would not occur at the same level as Alternatives A, E, and Alternative D-DEIS and D-FEIS. Because of subalpine forest's wildfire character (generally wind-driven during dry periods which results in distant spotting), it is projected that large wildfires will continue to occur under all alternatives in this coertype, and the extent of fire would be unlikely to differ significantly across alternatives.

Prescribed fire is largely conducted in non-forested coertypes, though an increasing amount of forested coertypes are being treated in the past few years. These burns did not target forested stands that are considered suitable for commercial timber products.

Blowdown is a random event, though typically mature stands are more affected than young stands of trees. Blowdown has the potential to occur within the next several decades, though would likely be at a scale of hundreds to a few thousand acres.

With regard to old growth seral stages, Revised Plan direction was updated to include double to triple the amounts of old growth managed for compared to the 1985 Plan, largely in response to species viability concerns, and from information in the Terrestrial Assessment (Regan et al. 2003, Romme 2002). Ten percent would be sought for most forested coertypes and 15% for spruce-fir. Because old growth typically has higher fuel loads and stands with little resistance to the disturbances, natural disturbance processes would be the dominant influences. Revised Plan direction for early seral conditions was retained, though modified to include both grass/forb and seedling/sapling stages (HSS1 and 2) rather than just the grass/forb stage (HSS1), as the timeframe of transition from stage 1 to 2 is relatively short (10 years). Young seral stages provide a balance of structural stages on the landscape for species and ecosystem process functioning. Revised Plan emphasis for the next planning period would be to obtain an inventory of old growth structure stage for use in planning and evaluating projects.

Effects from Livestock Grazing: Livestock and wildlife use of forage can affect the regeneration of forested coverts by impeding or delaying progression to more mature conditions if seedlings or saplings are consumed or damaged. This impact is addressed through forestwide standards and guidelines for livestock grazing, and current effects are anticipated to be reduced over time through application of these measures. Wildlife effects to this resource are not directly manageable, though Wyoming Game and Fish Department (WGFD) population objectives do consider carrying capacity. Ungulate grazing may also impact stand composition and structure by reducing the availability of fine fuels for fires. This is most noted in aspen stands, though it can also affect the edges of meadows and conifers where fire spread between stands may be reduced. This effect has not been quantified on the Bighorn National Forest, though is thought to be of significance.

Effects from Recreation and Travel Management: The effects of recreation (primarily dispersed) activities are negligible at the forestwide scale, and was not considered in the growth and yield modeling. At the site-specific/stand scale, recreation activities may impact regeneration of forested stands by suppressing young trees and even damaging mature trees.

Roads result in the direct removal or loss of forested vegetation. The loss of vegetation attributable to roads was not considered in the growth and yield modeling, as the loss is typically minor and along narrow, linear corridors that can be all but overshadowed by tree canopies.

Cumulative Effects

The analysis area for cumulative effects to habitat structure stages would include the Bighorn National Forest and the land immediately adjacent to it within approximately 3 miles. Trends applied to the larger Big Horn Mountains ecosection are noted below. Cumulative effects include past, present, and reasonably foreseeable (planning period) projects, as mentioned in the summary of activities table in the introduction to Chapter 3. The time period into the future considered would be the planning period (10-20 years). From this table, for habitat structure stages, the past and present activities of vegetation management and roads are the most significant, and the reasonably foreseeable future activities of subdivisions, highway widening, and private land vegetation management are most significant. In considering the direct and indirect effects described above, the following table presents a summary of how the alternatives are anticipated to cumulatively affect habitat structure stages.

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Table 3-19. Relative impact of alternatives on the Habitat Structure Stages.

Land Use Category	Less Impact ← Relative Impact → More Impact to Habitat structure stages					
Effects from land authorizations	No difference between alternatives					
Effects from recreation mgmt.	No difference between alternatives					
Effects from livestock grazing	No difference between alternatives					
Effects from timber harvesting	C	B	D-DEIS	D-FEIS	A	E
Effects from utility corridors and additional development of land on Forest	No difference between alternatives					
Effects from natural disturbance processes (fire, insects and disease, blowdown)	E	A	D-FEIS	D-DEIS	B	C

Historic forest management activities and land uses that have changed structure stages include timber harvest, road construction, recreation site development, reforestation, and fire suppression. Historic timber harvest has primarily replaced older mature forest stands with younger stands creating early seral structure stages similar to natural succession.

All alternatives would result in a range of structural stages within the HRV, as this range is so broad in terms of number of acres by structural stage. As the Forest represents the bulk of the forested acres for the Big Horn Mountains ecosection, this would indicate that structural stages in the ecosection would also remain within the HRV. Timber harvest on lands adjacent to the Forest would continue and affect structural stages and potential for natural disturbance agents. This is primarily focused on a scale of hundreds to a few thousands of acres on the southeast corner adjacent to the Forest, small areas along the west end of the Forest, and off the north end of the Forest on adjoining tribal lands.

Human-caused wildfire on adjacent land would have the potential to spread on to the Forest and change habitat structural stage. The spread of insects and disease from adjoining lands on to the Forest is not likely to be factor influencing habitat structural stages of forested vegetation.

Above and beyond all of the disturbances anticipated from forest management in any of the alternatives, natural processes would continue to dominate the habitat structure stages across the Forest, due to the relatively minor amount of forested acres being managed.

AFFECTED ENVIRONMENT

FRAGMENTATION AND CONNECTIVITY

Fragmentation: The alteration or reduction of patch sizes of covertypes from the HRV, or fragmentation, has become a management issue on many National Forests in the Rocky Mountains. It can be described as “human caused discontinuities” in natural landscapes (Knight et al. 2000). Fragmentation also occurs in aquatic systems in the form of dams and diversions, as addressed in the Aquatics section. This section will refer to terrestrial vegetation elements only. Fragmentation can be caused by roads, vegetation treatments, land ownership patterns and associated uses, and development. The existing patch size, connectivity of patches, and the amount of edge within the patches are the result of historical natural process and disturbances as modified by land uses in the more recent past and foreseeable future. Evaluation of fragmentation must clearly differentiate between the pattern of fragmentation and the effects of fragmentation.

Most research on this topic has occurred where human uses have caused a permanent change in the land use or coertype. Examples include subdivision/urbanization, conversions of timber or grass/shrub to agricultural land, or wide interstate highways. Research publications investigated by Fahrig (2003) described habitat loss as always having a negative effect on biodiversity, but noted that fragmentation (most often described at the patch scale instead of landscape) can have either positive or negative effects on species depending on the species. Furthermore, research often has not described the difference between habitat loss and habitat fragmentation.

The land management practices that influence vegetation on the Bighorn National Forest typically result in “perforation,” rather than “fragmentation” because the disturbance creates patches of disturbed habitat in a matrix of the existing coertype. Roads on the Forest are typically narrow, generally native surface and are thought to affect a narrow range of species and processes for all vegetation types. Although fragmentation will be the term used throughout this section, it is important to note the difference in terms or impacts normally described in the literature.

The Bighorn National Forest is a naturally fragmented compilation of covertypes. There is a high degree of natural interspersion of forested vs. non-forested covertypes, though the type, amount, and extent of each differs by soil types, moisture regimes, and disturbance processes throughout the Forest. The following table displays the ranges of forested to non-forested covertypes that are possible at the geographic area and forestwide scale. Where fires or harvest have occurred in forested areas, these areas are still classified as forested, as the soil types would lead them to regenerate similarly.

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Table 3-20. Forested and non-forested acres at the geographic area and forestwide scale on the Bighorn National Forest.

Scale of Analysis	Acres	Percent Forested	Percent Non-Forested
Bighorn National Forest	1,107,670	66%	34%
Shell Geographic Area	140,130	49%	51%
Piney-Rock Geographic Area	110,255	79%	21%

Historic livestock grazing and fire suppression altered disturbance processes (primarily fire) which generally resulted in larger patch sizes, particularly in the low elevation forested coetypes and all non-forested coetypes. In contrast, areas with roads and corresponding development (e.g., campgrounds, lodges) can break up the natural patch size in a permanent context. Timber harvest and prescribed burning alters successional stages of coetypes but is a non-permanent land use change. Current information on fragmentation and patch size was summarized in the forestwide assessment (see administrative record). Regionally and on the Forest, several research efforts have attempted to quantify fragmentation on forested coetypes.

Tinker et al. (1998) examined the influence of road building and clearcuts on core patch size at the watershed scale on the Bighorn National Forest. While documenting the changes in landscape pattern, no inference to effects on biodiversity were drawn. Core patch size was shown to be decreasing in response to roads and other human disturbance, the analysis did not examine how the pattern resulting from management compared to patterns from natural disturbance.

Beauvais (1997) conducted research on the Bighorn National Forest on mammal distributions relative to clearcuts, resulting in species associations to certain coetypes and structural stages. Changes in mammal community composition were described relative to the habitat changes, and recommendations were made to conduct additional clearcutting cautiously. Beauvais noted that thresholds of effects may not have been reached, but that older boreal forests should be maintained in such a state.

Merrill (1997) conducted research on avian diversity and species richness at various landscape scales on the Bighorn National Forest. This effort concluded “landscape heterogeneity [variation in coetypes] was generally a more important indicator of bird diversity than indices related to patch size or isolation or edge characteristics.”

Knight et al. (2000) in their review of fragmentation on the forests in the Southern Rocky Mountains, concluded that given a “lack of knowledge about the long-term effects of anthropogenic fragmentation, managers [should] be conservative and cautious when they contemplate new, intensive land uses for the 21st century.” The terrestrial assessment (Regan 2003) and the Historical Range of Variation (Knight and Meyer 2003) similarly identified that patch size may be smaller than what historically may have occurred, as clearcuts and other treatments have been more numerous and of smaller pattern than typical wildfires.

For the Bighorn National Forest, anthropogenic changes to covertypes are most concentrated in areas where more extensive road building has occurred. In a study near Pinedale, WY, Ingelfinger (2001) found that roads have an affect on the suitability of the habitat adjacent to them for certain avian species, demonstrating that roads create edge or fragment habitat. However, the results of this investigation may not provide much indication of fragmentation effects in the forested habitats of the bighorn because the study examined the effects of roads in dry, shrub steppe environments. The acres of suited land in management prescriptions where road building might occur is the most useful indicator of possible fragmentation for the most species because of the indirect effect of roads providing the means for associated land disturbing activities (e.g., campground construction, timber harvest). Fragmentation modeling such as FRAGSTATS (McGarigal and Marks 1995) was not conducted to look at the pattern of human-caused fragmentation because of the high amount of natural fragmentation on the Bighorn National Forest as described above, and from the existing research that has examined this subject on the Forest as described above.

It should also be noted that, since the 1970s, forested cover from timber harvest changed from larger clearcuts that more closely represented natural fire disturbances to smaller patch cuts that increased the amount of edge, all due primarily to changes in what seemed most beneficial for elk as the Management Indicator Species. Natural fragmentation within forested stands routinely occurs; for example, small fires from lightning strikes or insect attacks create small openings (0.1 – 5 acres) versus widespread fire or insect and disease epidemics that affect thousands of acres.

While reduction in patch sizes from roads has occurred in all vegetation types, the impact to forested covertypes is typically of the greatest research focus. The table below depicts the road density by geographic area for the Forest, an indicator of the amount of fragmentation that has occurred. Open roads include operational maintenance levels 2 – 5. Total road density includes the open roads plus closed roads (maintenance level 1) and user-created or unclassified roads. Road density figures do not include wilderness or private lands within the acreages figured. Trails were not included in these figures, and highways (14, 14A, 16 – 120 miles total) are only included in the forestwide figure at the bottom. Most roads have been constructed on flatter terrain and in non-forested community types on average due to reduce construction costs.

Table 3-21. Road densities in geographic areas on the Bighorn National Forest.

Geographic Area	Open Road Density (miles/sq. mile)	Total Road Density (miles/sq. mile)
Clear/Crazy Creek	1.3	2.2
Devil Canyon	0.8	1.4
Goose Creek	0.9	1.2
Little Bighorn	0.5	1.2
Paintrock	0.8	1.5
Piney/Rock Creek	0.2	0.2

Geographic Area	Open Road Density (miles/sq. mile)	Total Road Density (miles/sq. mile)
Shell Canyon	0.9	1.3
Tensleep Canyon	1.3	1.7
Tongue Canyon	0.7	1.4
Forestwide	0.8	1.36

For some terrestrial wildlife species (e.g., elk) associated with these habitats, road densities greater than one mile per square mile may be a threshold for suitability of use, depending on other factors (location of roads, topography, etc.) (Lyon et al 1991). In general, roads cause a reduction in habitat, which is the largest issue with regards to habitat fragmentation, and roads can cause a barrier to movement or a break in vegetation pattern that may disrupt some species use of the habitat.

With regard to timber harvest activities, less than 8% of the spruce-fir coertype and 33% of the lodgepole coertype have had timber harvest activities in them, indicating large acreages where landscape pattern has remained largely unchanged as compared to historic conditions. Areas harvested have also mostly included past tie hacking sites. Overall, approximately 18% of the forested acres on the Bighorn National Forest have had harvest activities in them (Regan et al. 2003).

Connectivity: Another aspect of fragmentation is the connectivity of patches—the degree to which patches have been isolated or cut off from other similar type patches. An example would be patches of old growth conifer still connected by forested coertypes to allow dispersion of some wildlife species associated with this structure. On the Bighorn National Forest, connectivity of vegetation has been influenced, to varying degrees, by road construction, small ski area development, utility corridors, livestock grazing, and land ownership. Timber harvest and wildfires have been sporadic in distribution, rather than continuous, allowing forested coertypes to persist within range of what likely historically occurred with minimal interruptions in continuity of coertypes.

Construction of primary roads, mainly objective maintenance level 3 through 5 roads (well-developed graveled roads to highways) has reduced connectivity of patches, though there are no currently known significant effects to any species associated with those types of habitat. Highways through the Forest (14, 14A, and 16) are currently of two-lane configuration with relatively low traffic volumes. The low traffic volumes and more narrow condition of these highways, they are not known or presumed to fragment patches and create barriers in migration patterns for species. Other National Forests have larger interstates and high traffic volumes that more readily contribute to formation of barriers and fragmentation effects to species distribution. Roads may also serve as dispersal routes for some wildlife and plant species.

Ski areas create a more permanent change in forested canopies and a potential reduction in connectivity as a result. The Bighorn National Forest has two small ski areas, with no likely addition of other ski areas. These two ski areas have had minimal impacts on connectivity or patch size due to their small size.

Utility corridors can impact connectivity and increase the amount of edge created. The existing utility corridors are comprised of low-voltage (less than 24 kv) electric lines and likely provide minimal amounts of disruption to connectivity because the width of the corridor is narrow and herbaceous vegetation remains.

Land ownership and the associated management of it can also have an affect on connectivity and fragmentation. Land managed to differing intents can create more edge or affect patch size as well. The Bighorn National Forest has perhaps the least amount of private or state in-holdings of any National Forest in the Rocky Mountain Region, indicating a low level of potential for this type of effect.

The changes to connectivity and potential fragmentation have largely been associated with roads. As stated in Knight et al. (2000), additional research is needed to understand this effect, but managers should proceed cautiously with additional roading. They further summarized that it appears that no vertebrate or vascular plant species has been extirpated in the Rockies because of fragmentation, however long-term effects are unknown. Much greater impacts in terms of urban development and associated roads are occurring around the Bighorn National Forest, though given the rural nature of the four-county area, these impacts are considerably less than in other more urbanized area such as the Colorado Front Range. This is also supported in the Terrestrial Assessment (Regan et al. 2003), where over 90% of the Bighorn National Forest was found to have high or moderately high ecological integrity. High integrity was defined as having low road density, limited timber harvest activity, limited livestock use, limited occurrences of invasive species, low departure from historical disturbance regimes, limited high-impact recreation, and small or few utility corridors.

ENVIRONMENTAL CONSEQUENCES FRAGMENTATION AND CONNECTIVITY

Direct and Indirect Effects

Fragmentation and connectivity have been of increasing concern in recent years. Fragmentation is primarily addressed through patch sizes; both fragmentation and connectivity are characterized by permanent or temporary losses or changes in habitat from uses such as roads. The effects of both fragmentation and changes in connectivity are difficult to measure or infer, particularly in naturally fragmented, heterogeneous landscapes.

Effects from Timber Harvest and Travel Management: In all alternatives, timber harvest and associated road construction would create patches and fragmentation. This effect would be greatest in Alternatives E and A, followed by Alternatives D-DEIS and D-FEIS, then B and C, respectively. Forestwide direction emphasizes creating patches similar

CHAPTER 3

AFFECTED ENVIRONMENT & ENVIRONMENTAL CONSEQUENCES

to those created by natural processes. However, public acceptance of larger patch sizes generated from clearcuts may temper this.

Timber harvest type affects connectivity or fragmentation differently; clearcutting has the most dramatic effect on patch size and fragmentation. Current Forest direction limits the size of clearcut units to 40 acres or less without Regional Forester approval, which can perpetuate the trend toward smaller patch sizes. For some covertypes (e.g., lodgepole pine), this creates a pattern which is likely different from the more common patterns prior to forest management (based on HRV). Shelterwood and uneven-aged harvest types affect fragmentation and connectivity less; however, they also involve more entries into stands creating more disturbance over time as compared to clearcut methods.

An indicator of likely effects to patch sizes would be the anticipated levels of timber harvest and road building in each alternative. Refer to the previous section to view a table describing anticipated road increases, and refer to the forested vegetation section for tables showing anticipated timber harvest levels by alternative. Of smaller effect is the skidding typically employed in each timber harvest. Skidder routes create narrow pathways within the stand that are often quickly regenerated with vegetation, and are of minimal effect to residual soil and vegetation resources.

The acres affected overall by timber production in the most aggressive harvest alternative, E, would be about 40% of the total forested acres (as indicated by suited acres). Actual timber harvest acres in the next planning period (10-20 years) would be significantly less than this 40% due to rotation ages, economics, and other factors. It is unlikely that timber harvest under any alternative would result in large enough changes in actual connectivity of habitat to be measurable, as vegetation changes, other than roads, are not permanent.

Though any additional road building would increase fragmentation over current levels, roads constructed for timber harvest are not typically large enough or have high enough traffic volume to measurable impact connectivity for most species. In addition, reductions in road density associated with projects may help offset some effects over time. It is estimated that approximately 4 miles of road per year would be decommissioned or reconstructed by alternative, largely in response to road maintenance backlogs and resource needs, and largely associated with user-created roads (not FS system roads).

The following table shows the anticipated total road densities (Level 1 – 5) by alternative at the forestwide scale, not including existing wilderness or private land. Also included are the current estimate of approximately 274 miles of user-created roads, though these would likely decline over time through rehabilitation and enforcement. As shown, there is little difference in road density between alternatives. Anticipated miles of road construction under each alternative are listed in Table 3-13.

Table 3-22. Forestwide anticipated road densities and road construction by alternative after the first decade projected on the Bighorn National Forest.

Alternative	Total Road Density (miles/sq. mile)
A	1.37
E	1.37
B	1.36
C	1.36
D-DEIS	1.36
D-FEIS	1.36
Current Condition	1.36

Effects from Disturbance Processes (Fire, Insects and Disease): Patch sizes created with prescribed fire are likely to be between those created by timber harvest and those created by natural processes. Patches created by prescribed fire would often be designed to emulate natural patch size shape and connectivity, however patch size would still be constrained by standards and guidelines for other resources such as riparian areas, recreation, and scenic resources. Anticipated levels of prescribed burning by alternative, including both forested and non-forested communities, are described in the following table.

Table 3-23 Acres of prescribed burning anticipated on the Bighorn National Forest.

	Alternative A	Alternative B	Alternative C	Alternative D-DEIS	Alternative D-FEIS	Alternative E
Forested	500	1,100	250	1,050	1,150	250
Non- Forested	2,000	3,000	1,500	2,500	2,600	2,500

Over time, natural processes (endemic levels of insects and diseases and small fires) would create numerous very small patches (<5 acres) and (epidemic levels of insects and stand replacement fires) would create a smaller number of very large patches (>1,000 acres). Since insect risk is medium high or high on more than 50% of the forested acres, and since insect damage is associated with population levels and drought cycles, it is possible that many of these high-risk acres would be attacked within the next 50 years.

Large stand replacement fires are associated with fuel loading and drought cycles. Refer to the Fire and Fuels section for details. It is possible that many of these acres would burn in single year or in a series of drought years. The effects of wind can be greater where trees are already affected by root diseases. After wind events, spruce beetle epidemics can spread out from the blowdown. Wind events can also be followed by large-scale fire events that can create extensive areas of severely burned soil and vegetation from the loading of large fuels.

Natural processes that operate without control or suppression have the potential to create large patch sizes. In areas without roaded access, control and suppression actions are less often attempted and less often successful at limiting the size of patches created. Those alternatives (C and B) with the greatest emphasis on natural processes will, over time, have the largest patch sizes. Although the other alternatives with the greatest allocation to management category 5 would provide some management emphasis against these processes, it is also likely that natural processes will continue to dominate on the landscape, being the largest driver of patch size over time.

Effects from Special Area Designations: The addition of four Research Natural Areas (RNAs) under Alternatives B, C, and D-DEIS, and two in D-FEIS would provide opportunities to track natural patch size and impacts to connectivity and fragmentation. This opportunity may not occur in Alternatives A and E. In addition, RNAs help maintain high ecological integrity of composition (covertypes). To date, research has not been conducted on the RNAs on the Bighorn National Forest.

Cumulative Effects

The analysis area for cumulative effects to biodiversity composition would include the Bighorn National Forest and the land immediately adjacent to it within approximately 3 miles. Trends applied to the larger Big Horn Mountains ecosection are noted below (limber pine). Cumulative effects include past, present, and reasonably foreseeable (planning period) projects, as mentioned in the summary of activities table in the introduction to this chapter. The period considered into the future would be the planning period (10-20 years). From this table, for fragmentation and connectivity, the past and present activities of vegetation management and roads are the most significant, and the reasonably foreseeable future activities of subdivisions, highway widening, vegetation management on adjoining lands, and increased recreation use (OHV, demographics) are most significant.

In considering the direct and indirect effects described above, the following table presents a summary of how the alternatives are anticipated to cumulatively affect fragmentation and connectivity.

Table 3-24. Relative impact of alternatives on the habitat fragmentation and connectivity.

Land Use Category	Less Impact← Relative Impact →More Impact to composition					
Effects from land authorizations	No difference between alternatives					
Effects from motorized recreation mgmt. (potential for user created roads and increased dispersed recreation use associated with anticipated road construction)	C	D-FEIS	B	D-DEIS	A	E
Effects from livestock grazing	No difference between alternatives					
Effects from timber harvesting (tie to suited acres and continuation of smaller patch sizes)	C	B	D-DEIS	D-FEIS	A	E
Effects from utility corridors and additional development of land on Forest	No difference between alternatives					
Land available for locatable minerals and oil and gas	C	B	D-DEIS	D-FEIS	A	E

Fragmentation and connectivity impacts would likely continue to escalate on lands adjacent to the Forest through urban development or other land uses. This would place a higher value on retaining more historic patch sizes on the Forest to offset this effect. With the dominance of natural disturbance processes, there would likely be a strong element of this occurring, regardless of alternative. Departures from a more historic norm of patch sizes may occur through timber harvest activities on the Forest, which would be greatest in Alternatives E and A, and less in both D-DEIS and D-FEIS, B, and C, respectively.

Highways can represent the largest possible potential for impacts to connectivity and fragmentation for the most species. There are no anticipated increases in major highways in the next planning period either adjacent to or within the Forest. Similarly, any development (e.g., through campgrounds, lodges, utility corridors, etc.) would remove habitat and increase fragmentation. There would likely be minimal to no additional permanent disturbances of these types on the Forest other than a possible rest area along Highway 16, and possibly a few additional hiking trails. These activities would occur regardless of alternative implemented.

In viewing the lands adjacent to the Forest and in the rest of the Big Horn Mountains subsection, it is also evident that the Forest has much lower road density than the surrounding areas. This may place an inherently higher value of lands on the Forest, both socially and from a resource standpoint, to take a cautious approach in increasing road densities on the Forest.

AFFECTED ENVIRONMENT SNAGS AND COARSE WOODY DEBRIS

Snags and coarse woody debris are important forested ecosystem components; they provide habitat necessary for many species and help maintain soil productivity by adding organic matter to the soil horizon and maintaining the mycorrhizae crucial to the decay processes.

The existing levels of snags and coarse woody debris are the result of historical natural process and disturbances and human activities/uses. Snag residence time varies by climate and cause of mortality. For Englemann spruce in Utah killed by spruce beetle, 84% of the killed trees were still standing after 25 years (Lowery 1982, Mielke 1950). In a Colorado study for Engelmann spruce killed by spruce beetles, 8% of the snags had fallen after 10 years and 28% after 20 years (Lowery 1982, Hinds et al. 1965). For fire-killed lodgepole pine in Montana, very few snags fell the first 2 years after the fire; then for snags smaller than 3 inches dbh,² 28% fell each year. For snags 3 to 8 inches dbh, 8% fell yearly, and snags larger than 8 inches dbh had a sporadic rate with some predicted to stand indefinitely (Lyon 1977). Snags with a variety of “soundness” are desirable on the landscape, as some species require soft and others hard snags. Soundness is typically a function of the decay time. Typically more species utilize larger, taller snags.

Activities that may reduce snag abundance include mechanical harvest, firewood gathering, fire, and wind. Though fires may consume snags, typically many more are generated if the fire is severe enough to kill portions of the mature canopy. In terms of snag size and abundance, the spruce-fir coevertype produces the largest snags and the most per acre of any coevertype on the Bighorn National Forest. Trees in lodgepole stands typically do not grow as large and burn more frequently than spruce-fir; Douglas-fir stands may be more similar to spruce-fir in abundance and size. The majority of the mechanical timber harvest activity has taken place in lodgepole pine and spruce-fir coevertypes. However, these activities have impacted less than 20% of the forested acres. Mechanical harvest activities have occurred on approximately 33% of the lodgepole pine coevertype and less than 8% of the spruce-fir acres on the Forest.

To evaluate the current amount of snags, an analysis of Stage II timber inventory data, was conducted. The following table illustrates the amount of snags by coevertype and structural stage from these inventories, which are typically conducted in areas scheduled for harvest activities. The highest number of snags and largest diameter are typically attributable to spruce-fir stands, as they naturally produce larger trees and a greater abundance of snags, particularly where elements of insects and disease may be working. While this table indicates a range of 10-40 snags per acre in spruce-fir, levels of 5-30 snags per acre are more typical in lodgepole pine, due both to previous harvest emphasis and the natural

² Dbh – diameter breast height; the diameter of a standing tree at a point 4 feet, 6 inches from ground level.

potential for snags in the lodgepole type. Douglas-fir has a similar abundance of snags as the spruce-fir type.

Some snag-dependent species, such as three-toed woodpeckers, are more directly associated with spruce-fir, due primarily to prey association (spruce beetle). No species are known to be limited to only lodgepole pine snags. General direction in the 1985 Plan was for 20 to 30 snags per 10 acres, and 90 to 110 snags per 100 acres, with sizes varying by covertype. The Forest has easily met this requirement as shown in the figure above. Typically, snag inventories have been conducted at the project level where reductions in snag abundance are anticipated. Projects are designed to ensure retention of an adequate number and size and recruitment trees typically in excess of the minimum forest plan requirements.

Many sites in roadless or wilderness areas have not been inventoried. These areas generally have an abundance of snags due to a lack of disturbances associated with roads (firewood, timber harvest). Approximately 354,600 forested acres occur in roadless areas (updated 2005 inventory), which is approximately half of the total forested acres. Roadless areas (2005 inventory) represent approximately 53% of the Forest, including the Cloud Peak Wilderness. These sites, in conjunction with the inventoried sites, demonstrate the abundance of snags on the Forest, and this is likely within HRV.

Coarse woody debris (CWD) refers to the amount, size, and length of material found on the forest floor. CWD is important both for species needs and for soil nutrient processes affecting regeneration of forested sites. Snags contribute to the amount of CWD over time. Natural fluctuations in CWD occur through disturbance processes. A high amount may occur after a blowdown or following an insect and disease outbreak, and fire may consume CWD during more severe events. However, snags created during a fire provide the next layer of CWD. Existing levels of CWD may be manipulated during timber harvest due to skidding operations (repositioning CWD) or slash treatment (e.g., burning). However, timber harvest also typically creates additional CWD as cull trees are left on site, as well as tree tops. CWD has not been inventoried on the Forest, but would likely have similar abundance and distribution as described previously with the snags.

Graham et al. (1994) examined amounts of coarse woody material needed to maintain ecosystem functions by habitat type. They found that between 3 and 25 tons per acre of coarse woody debris are needed to maintain ecosystem functions. Similarly, Bull et al (1997) describe amounts needed for terrestrial wildlife. This amount is typically readily obtained on timber harvest units, both pre and post treatment, on the Bighorn National Forest.

With regard to the Big Horn Mountains ecosection, the Bighorn National Forest has the most forested acres, and the least amount of road building, indicating it probably has the highest abundance of snags and CWD in relation to the rest of the section.

ENVIRONMENTAL CONSEQUENCES

SNAGS AND COARSE WOODY DEBRIS

Direct and Indirect Effects

The level of snags and coarse woody debris under each alternative will vary based on the management area allocations. In management areas where natural processes predominate, the level of snags and coarse woody debris will approach ecosystem maximums, particularly as the bulk of the forested acres continue to mature. These management prescriptions are maximized in Alternatives C and B, tapering off to the least in Alternatives A and E (for additional discussion of management area allocations by alternative, see FEIS Chapter 2). Aspen coverts provide some of the most valuable snags due to the softer nature of the wood and other attractions of the habitat type to species. Snags are typically left on site when aspen regeneration treatments are conducted.

Snag and coarse woody debris guidelines were updated in the Revised Plan to reflect new knowledge. The desired amounts of both elements were increased compared to levels in the 1985 Plan.

Effects from Disturbance Processes (Fire, Insects, and Disease Management): Stand replacement fires and insect and disease incidents will create high density snag patches in some areas that will eventually become high density patches of CWD. Subsequent wildfires in these high density snag/CWD patches would likely consume most of the snags and woody debris. Species such as the three-toed woodpecker are adapted to take advantage of high densities of insects and the associated snags. This natural ebb and flow of snags and CWD typically moves across the landscape, with associated fluctuations in abundance and distribution of these components. Alternatives with greater emphasis on natural processes (C and B) would likely retain higher amounts of snags but also exhibit more fluctuations in levels as compared to alternatives with higher timber harvest (A and E).

Effects from Timber Harvest, Recreation, and Travel Management: Timber harvest can result in a loss of snags and future coarse woody debris in harvest units and along roads where subsequent fuelwood gathering takes place (Tinker et al. 1998; Tinker 1999; Tinker and Knight 2000 and 2001; Tinker and Baker 2000; Brown and See 1981; Brown et al 2001). The loss of snags and coarse woody debris would potentially be greater in alternatives with higher levels of timber harvest (A and E) and less in those alternatives with greater emphasis on natural processes (Alternative D-DEIS and D-FEIS, B, and C, respectively). However, levels that are recommended by current literature for both species habitat and ecosystem functioning processes can be maintained following these activities. In areas where timber harvest and fuelwood gathering take place, there may be differences in long-term amounts of both of these resources as compared to what may have historically occurred, though at the forestwide scale the levels and distribution are well within HRV. Modeling results (on file in the administrative record) for snag numbers from the Forest

Vegetation Simulator portion of the harvest model also demonstrate snag abundance above forest plan minimums for each alternative.

Firewood gathering that removes snags is permitted except in areas closed to fuelwood collection. Standing dead trees with bird cavities (holes), nests, or wildlife tree signs and marked trees or trees with signs or paint are not allowed to be cut. Most fuelwood collection occurs approximately 150 feet from open roads.

Removal of dead standing trees that pose a safety hazard occurs in campgrounds, administrative sites and along roads. Felling of these snags contributes to a reduction in snag abundance. If these snags are felled and not removed from the site, they would contribute to coarse woody debris.

Roads constructed in support of harvest activities can remove snags and coarse woody debris. The potential for road construction is greater in Alternatives E and A, decreasing with Alternative D-DEIS and D-FEIS, B, and least in C. Given the narrow, linear nature of this disturbance, it is not likely to be a significantly impact snag and coarse woody debris abundance on the Forest.

Cumulative Effects

The analysis area for cumulative effects to biodiversity composition would include the Bighorn National Forest and the land immediately adjacent to it within approximately 3 miles. Trends applied to the larger Big Horn Mountains ecosection are noted below (limber pine). Cumulative effects include past, present, and reasonably foreseeable (planning period) projects, as mentioned in the summary of activities table in the introduction to Chapter 3. The time period into the future considered would be the planning period (10-20 years). From this table, for snags and coarse woody debris, the past and present activities of vegetation management and roads are the most significant, and the reasonably foreseeable future activities of subdivisions, highway widening, and private land vegetation management are most significant.

In considering the direct and indirect effects described above, the following table presents a summary of how the alternatives are anticipated to cumulatively affect snags and coarse woody debris.

Table 3-25. Relative impact of alternatives on snags and coarse woody debris.

Land Use Category	Less Impact ← Relative Impact → More Impact to composition					
Effects from land authorizations	No difference between alternatives					
Effects from natural disturbance processes	E	A	D-FEIS	D-DEIS	B	C
Effects from livestock grazing	No difference between alternatives					
Effects from timber harvesting and associated fuelwood harvest (tie to suited acres)	C	B	D-DEIS	D-FEIS	A	E
Effects from utility corridors and additional development of land on Forest	No difference between alternatives					
Land available for locatable minerals and oil and gas	C	B	D-DEIS	D-FEIS	A	E

Under any alternative, it is likely that snag abundance and distribution would continue to be at levels necessary for ecosystem processes with application of revised standards and guidelines. There would be more risk associated with implementation of Alternatives A and E, as higher levels of timber harvest and fuelwood gathering would likely occur, reducing snags and possibly coarse woody debris available. However, natural disturbance processes would continue to dominate in terms of effects to amounts and distribution, as by alternative, only between 7 and 30% of the forested acres would be managed for timber production. It is noted that long-term declines in CWD and snags are likely over the long-term with timber harvesting (Tinker and Knight 2000 and 2001), and this has potential to occur on areas managed for timber harvest in the long-term.

As the Forest comprises the majority of the forested acres within the Big Horn Mountains ecosection, the effects on the Forest would represent the trend and condition for the rest of the ecosection. As timber harvest is conducted on lands adjacent to the Forest, there are further depletions of these resources, however the scale and extent of those effects are small, and primarily occur on the southeast corner of the Forest, though with some activity on the north and west flanks.

Summary of Environmental Consequences – Ecosystem Analysis

In general, forest succession and natural disturbance processes would be the primary agents of change for biodiversity components, with stands growing older and denser until stand-replacing events occur. Given the progression toward more mature structural stages and the likelihood of natural disturbances, the limited extent of timber harvest and other management activities described above would not be major influences on Forest structural stages in any alternatives. Fire suppression in areas dominated by Management Category 5

prescriptions may reduce opportunities for more large-scale disturbances, however drought and wind events associated with fires largely determine where disturbances occur regardless of management prescription boundaries. Since the majority of the Forest is represented by long fire return intervals, historic fire suppression has had little effect on all but the shrub, Douglas-fir, and ponderosa pine ecosystem components.

Forest Service management activities would remain close to current levels and outputs under Alternatives D-DEIS and D-FEIS. Alternatives C and B would have less commercial timber harvest activity than presently occurs; Alternatives A and E would have more. Timber harvest and road construction carries some risks to resources such as vegetative community composition (noxious weed introduction), riparian functioning (stream crossings), old growth, snags, and CWD, and fragmentation as discussed above.

Livestock grazing would continue similarly across all alternatives, with effects greatest in riparian areas and meadow communities, and improvements in those community types occurring slowly over time.

Recreation use is another potential source of impacts. Recreation use can affect riparian areas, wilderness meadows, and other sites, though mitigation measures may correct some deficiencies. In general, recreation activities are a minor influence on biodiversity elements at the forestwide scale; however, there may be localized impacts. At the site-specific/stand scale, recreation activities may impact regeneration of forested stands by suppressing young trees and even damaging mature trees. Dispersed and developed recreation campsites affect composition by removing vegetation or changing vegetative composition on the site. An increase in recreation use is predicted under all alternatives.

With natural processes as the major influence, ecosystem components and functioning would largely remain within HRV across all alternatives. However, there may be localized exceptions where noxious weeds or non-native insects and disease expand and change vegetative composition.

All alternatives have updated standards and guidelines with positive benefits for both habitats and ecosystem processes. These updates would not occur under a No Action Alternative as described in FEIS Chapter 2.

Historic land uses such as timber harvesting and roads have created various patch sizes and arrangements on the landscape of the Bighorn National Forest. Historic and existing timber management direction and policy, along with public acceptance has limited the creation of large patches. The arrangement of harvest units in the past was influenced by acceptable road locations, types of harvesting equipment, and economics of harvest. Other land uses such as developed recreation sites and special use sites have often been based upon historical uses and feasible locations to provide desired outcomes (e.g., electronic sites on mountain tops). Large-scale disturbance events such as fire and insects and disease would continue to shape the most vegetation patterns in forested areas, with patterns persisting for 100-300 years into the future.

Single Species Analysis

This Single Species Analysis discloses information about species selected and determined to require special attention due to unique habitat requirements or suspected threats to their continued viability. A viable population is one that has the estimated numbers and distribution of reproductive individuals to ensure its continued existence is well distributed in the planning area. The Single Species Analysis corresponds to national guidance in addressing species viability requirements (Holthausen 2002) and is a part of the overall Viability Analysis Process as described in the administrative record documents. The approach used incorporates the most recent knowledge and scientific findings available for individual species and their habitats.

For analysis purposes, species were divided into five categories: 1) federally threatened, endangered, proposed, or candidate species; 2) Forest Service sensitive species; 3) species of local concern; 4) management indicator/focal species (MIS); and 5) demand species. The first three categories represent species at risk from a viability perspective. Only one of the selected MIS is also a species-at-risk. Details of the species selection process are contained in the Species Emphasis Categories document on file in the administrative record. Existing conditions and environmental consequences for federally listed (T&E) species are addressed in the Biological Assessment (FEIS Appendix F), and Forest Service sensitive species are addressed in the Biological Evaluation (FEIS Appendix K). For details on the process used to select MIS, refer to the Selection Process for Management Indicator Species document in the administrative record. Species assessments, also in the administrative record, were conducted for each MIS and at-risk species, with details on the species' habitats, known distributions, threats, and conservation measures. A management strategy for rare plants was also developed for the Forest in conjunction with plan revision efforts, as described in the administrative record.

For each of the species at risk from a viability perspective, the potential impact of implementing each alternative was evaluated. Elements of species' habitat trends (distribution and amount) and population trends (abundance, distribution, dispersal ability) likely resulting from Forest Service management activities were summarized in viability outcomes for each alternative. These outcomes were assessed by evaluating the main risks associated with the species or its habitat, and how different alternatives would affect those. The process used to arrive at these determinations and outcomes is described in detail in the Viability Analysis Process document in the administrative record. In addition, viability outcomes for species are listed given known cumulative effects, such as impacts that occur off Forest or from activities other than Forest Service responsibilities. These cumulative effects are described in the introduction to this chapter and include the past, present, and reasonably foreseeable future potential impacts in the next planning period. Viability for any species cannot be ensured due in part to effects in other areas of a species range, and non-management induced disturbances or catastrophic events affecting their habitat. In addition, little information is known about the current distribution or habitat for many of

the species, contributing to ambiguity when applying viability outcomes. The following outcomes are displayed for each species by alternative:

- ♦ **Outcome A:** Suitable ecological conditions are broadly distributed and of high abundance across the historical range of the species within the planning area. The combination of distribution and abundance of ecological conditions provides opportunity for continuous or nearly continuous intraspecific interactions for the species.
- ♦ **Outcome B:** Suitable ecological conditions are either broadly distributed or of high abundance across the historical range of the species within the planning area, but there are gaps where suitable ecological conditions are absent or only present in low abundance. However, the disjunct areas of suitable ecological conditions are typically large enough and close enough to permit dispersal among subpopulations and potentially to allow the species to interact as a metapopulation across its historical range within the planning area.
- ♦ **Outcome C:** Suitable ecological conditions are distributed frequently as patches and/or exist at low abundance. Gaps where suitable ecological conditions are either absent, or present in low abundance, are large enough that some subpopulations are isolated, limiting opportunity for species interactions. There is opportunity for subpopulations in most of the species range to interact as a metapopulation, but some subpopulations are so disjunct or of such low density that they are essentially isolated from other populations. For species for which this is not the historical condition, reduction in overall species range from historical within the planning area may have resulted from this isolation.
- ♦ **Outcome D:** Suitable ecological conditions are frequently isolated and/or exist at very low abundance. While some of the subpopulations associated with these ecological conditions may be self-sustaining, there is limited opportunity for population interactions among many of the suitable environmental patches. For species for which this is not the historical condition within the planning area, reduction in overall species range from historical condition within the planning area may have resulted from this isolation.
- ♦ **Outcome E:** Suitable ecological conditions are highly isolated and exist at very low abundance, with little or no possibility of population interactions among suitable environmental patches, resulting in strong potential for extirpations within many of the patches, and little likelihood of re-colonization of such patches. There has likely been a reduction in overall species range from historical within the planning area, except for some rare, local endemics that may have persisted in this condition since the historical period.

The following outcomes are used to describe effects to species from overall cumulative effects, including those activities not associated with Forest Service management or from time spent in habitat off of the Forest. These would include activities listed in the table in the introduction to this chapter, as well as those far removed from the local area due to the migratory behavior of some species.

- ♦ **Outcome I:** The combination of environmental and population conditions provides opportunity for the species to be broadly distributed and of high abundance across its historical range within the cumulative effects analysis area. There is potential for continuous or nearly continuous intraspecific interactions at high population size.
- ♦ **Outcome II:** The combination of environmental and population conditions provide opportunity for the species to be broadly distributed and/or of high abundance across its historical range within the cumulative effects analysis area, but there are gaps where populations are potentially absent or present only in low density as a result of environmental or population conditions. However, the disjunct areas of higher potential population density are typically large enough and close enough to other subpopulations to permit dispersal among subpopulations and potentially to allow the species to interact as a metapopulation across its historical range within the cumulative effects analysis area.
- ♦ **Outcome III:** The combination of environmental and population conditions restrict the potential distribution of the species, which is characterized by patchiness and/or areas of low abundance. Gaps where the likelihood of population occurrence is low or zero are large enough that some subpopulations are isolated, limiting opportunity for species interactions. There is opportunity for subpopulations in most of the species range to interact as a metapopulation, but some subpopulations are so disjunct or of such low density that they are essentially isolated from other populations. For species for which this is not the historical condition within the planning area, reduction in overall species range from historical condition may have resulted from this isolation.
- ♦ **Outcome IV:** The combination of environmental and population conditions restrict the potential distribution of the species, which is characterized by areas with high potential for population isolation and/or very low potential abundance. While some of these subpopulations may be self-sustaining, gaps where the likelihood of population occurrence is low or zero are large enough that there is limited opportunity for interactions among them. For species for which this is not the historical condition within the planning area, reduction in overall species range from historical has likely resulted from this isolation.

- ♦ **Outcome V:** The combination of environmental and population conditions restricts the potential distribution of the species, which is characterized by high levels of isolation and very low potential abundance. Gaps where the likelihood of population occurrence is low or zero are large enough there is little or no possibility of interactions, strong potential for extirpations, and little likelihood of recolonization. There has likely been a reduction in overall species range from historical within the planning area, except for some rare, local endemics that may have persisted in this condition since the historical period.

A summary of the determinations and viability outcomes for each species is included in this section. The Revised Plan contains many positive conservation measures for species viability in the form of goals, objectives, standards, guidelines, and monitoring. These measures apply to all of the alternatives considered in detail. A list of these conservation measures occurs within the individual Species Assessments and in the Viability Process document in the administrative record.

Existing conditions and evaluations of effects to MIS and Demand species are summarized in the Aquatics (fisheries) and Terrestrial Wildlife sections of this chapter, as they were selected to represent these resources and the associated habitats.

AFFECTED ENVIRONMENT THREATENED AND ENDANGERED SPECIES

The list of species evaluated is based on a letter to the Forest from the U.S. Fish and Wildlife Service (USFWS) dated March 24, 2004. Two federally listed species were included for the Bighorn National Forest Land and Resource Management Plan revision process. No candidate or proposed species were included.

Federally listed threatened and endangered species are those plant and animal species formally listed by the USFWS under authority of the Endangered Species Act of 1973, as amended. An endangered species (E) is defined as one which is “in danger of extinction throughout all or a significant portion of its range.” A threatened (T) species is defined as one “that is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range...” (FSM 2670.5 (81) and FSM 2670.5 (211), respectively). A proposed species (P) is defined as one in which “information now in possession of the FWS (that) indicates that proposing to list the species as endangered or threatened is possibly appropriate, but for which conclusive data on biological vulnerability and threats are not currently available to support proposed rules.” (FSM 2670.5). Candidate species are those for which information exists to support a listing, however further study is required or other priorities are affecting listing decisions.

In 2002 and 2003, the Forest conducted surveys for potential habitat and occurrences of the mountain plover (then P) and the Ute’s ladies’-tresses (T). No potential habitat was found,

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AFFECTED ENVIRONMENT & ENVIRONMENTAL CONSEQUENCES

no observations of the species occurred, and no historical observations were known to have occurred, so these species have been dropped from consideration.

Gray wolves (T) and grizzly bears (T) have the potential to occur on the Bighorn National Forest. Grizzly bears have not been sighted on the Forest, and the Wyoming Game and Fish Department's Bear Management Plan does not identify the Big Horn mountains as a desired place to manage for grizzlies due to the high potential for human interaction. Any management activities undertaken with grizzlies by the USFS or the Wyoming Game and Fish Department (WGFD) would be done in coordination with the USFWS as required by law.

Wolves have been sighted on or near the Forest in recent years, with some control activities due to predation on sheep and cattle. It is not known if a pack will develop on the Forest based on the continued potential for this interaction. The WGFD's Draft Wolf Management Plan (2003) dictates necessary processes in dealing with wolves, and the plan may be amended due to recent disputes. Should depredation of livestock using the Forest occur from wolves, they would most likely be removed by the USDA Wildlife Services. This activity would not be of jeopardy to the continued existence of wolves in Wyoming, as the Big Horns are outside of the recovery area and the wolves are a non-essential experimental population. In addition, wolf numbers have reached the recovery objective. Changes that may occur in the state's Wolf Management Plan would not likely cause a change in management in wolves for the Bighorn National Forest. As the Forest has lower road densities than surrounding lands, wolves may be attracted to the Forest, and may also utilize big game winter range habitats as foraging areas. Management direction (standards or guidelines) in the Forest Plan is not necessary due to the experimental status of the wolf as described in the EIS prepared for their reintroduction (1994), and the Bighorns are not a prime recovery area. Refer to the Biological Assessment (FEIS Appendix F) for further information.

Bald eagles use the Forest during migratory periods for foraging purposes. No nesting or winter roosting has been observed or is known to have historically occurred on the Forest. Bald eagle populations have improved greatly over the past few decades, largely due to the ban of use of DDT. There has been some discussion of de-listing the species, which may occur in the next planning period.

Canada lynx historically occurred on the Forest, and there have been some recent reports of sightings, though unconfirmed. It is not known if a self-sustaining population of lynx ever occurred on the Forest, but it is estimated that observations may be a result of influx from other source populations. The Forest conducted hair snare sampling for three seasons from 2000 – 2002, with no lynx detected on the routes. Lynx denning habitat includes high levels of coarse woody debris and overhead canopy; foraging habitat involves areas where primary prey such as snowshoe hare or red squirrel may occur.

ENVIRONMENTAL CONSEQUENCES THREATENED AND ENDANGERED SPECIES

Effects determinations correspond to determinations required by Section 7 of the ESA, and indicate the estimated viability of the species. The USFWS is responsible for concurring with effects determinations and determining if a proposed action is likely to jeopardize the continued existence of a species, indicating its viability at a scale larger than a National Forest. Effects determinations include “no effect” to the species, or “may affect, not likely to adversely affect”, “may affect, likely to adversely affect”, or “may affect, beneficial affect.” The following table displays information about the effects determination for each of these species as described in the Biological Assessment (FEIS Appendix F). Consultation with the USFWS was completed for the Revised Plan and FEIS based on the Biological Assessment (FEIS Appendix F), with concurrence on these determinations. Effects determinations were the same for all alternatives due to the incorporation of the same management direction in terms of standards and guidelines. There was not a dramatic enough difference between alternatives in terms of the effect of application of management prescriptions at the forestwide scale to further alter the determinations, though risk to species in general would be less where fewer acres are intentionally disturbed, such as in Alternatives C and B.

Table 3-26. Effects determinations for threatened (T) species on the Bighorn National Forest.

	Canada lynx (threatened)	Bald eagle (threatened)
Determination	May Affect, Not Likely to Adversely Affect	May Affect, Not Likely to Adversely Affect
	Viability outcome B	Viability outcome A
	Cumulative viability outcome IV	Cumulative viability outcome II

Bald Eagle

As bald eagles occur only intermittently on the Forest, population factors were not well represented in viability determinations. Regionally the population trend of these species has improved, due largely to changes in protection for the species from pesticides and disturbance or takings. It is likely that a continued improved trend would occur regardless of the selected alternative. To guide project implementation, nest site and winter roost protection measures for habitat are included in the plan direction (standards and guidelines). Under all alternatives, there are no anticipated changes that would affect foraging habitat for this species. However, existing uses (e.g., powerlines) and other potential disturbances on the Forest prevent a “no effect” determination, though these impacts are thought to be non-significant and allowed for an “A” viability outcome. With regards to a cumulative viability outcome, habitat conditions and potential disturbances on lands adjoining the Forest where most habitat use occurs could result in degraded conditions in the future, resulting in a “B” viability outcome. The Biological Assessment

(BA) discusses direct, indirect, and cumulative effects of each alternative in detail supporting the determinations made above.

Canada Lynx

As it is unknown whether Canada lynx occur on the Forest, the Forest would comply with recent direction in the Canada Lynx Conservation Agreement signed with the USFWS (USDA Forest Service 2005). The Forest would adopt the most current management direction from the Lynx Conservation Assessment and Strategy (LCAS) (Ruedegier et al 2000) and the Northern Rockies Lynx Amendment (USDA Forest Service 2004) by tiering to the amendment process. This amendment process, once completed, may contain different management direction than the LCAS, and as such would be incorporated into the Revised Plan through amendment. However, as described in the Conservation Agreement, the Forest would only apply these conservation measures should lynx be observed on the Forest. Should a lynx occur on the Forest, this management direction would apply to mapped lynx habitat as identified in Lynx Analysis Units (LAUs), for the remainder of the planning period. In addition, a ruling on critical habitat for lynx by the USFWS may affect the extent to which the Bighorn National Forest manages for lynx. A strategy was added to the Revised Plan between Draft and Final to incorporate the intent to manage for lynx based on any changed conditions that any of these processes (amendment, lynx observation, or critical habitat determination) create. Due to the more isolated juxtaposition of the Forest in relation to larger core habitats, it is not known if lynx would seek out the Forest as potential habitat that would likely be used by a recovering lynx population in the northern Rockies.

Most of the plan direction applies to Lynx Analysis Units (LAUs) developed in conjunction with the USFWS to show potential and suitable habitat. The previous management direction (standards and guidelines) for lynx included in the DEIS and draft revised plan were removed, as they incorporated the direction from the Draft Preferred Alternative (E) in the Northern Rockies amendment process. The Forest, in consultation with the USFWS, has instead reverted back to following direction for lynx in the LCAS (described as Alternative B in the Northern Rockies DEIS) until such time as the Northern Rockies Amendment process is completed. That planning process is considering a range of alternatives for managing lynx habitat. This FEIS tiers to the Northern Rockies DEIS and amendment process by incorporating by reference the Northern Rockies analysis related to lynx management direction into this effects analysis. Any of the alternatives considered in the Northern Rockies DEIS could be adopted for the Bighorn National Forest, with the corresponding effects analysis described.

The BA (FEIS Appendix F) discusses direct, indirect, and cumulative effects of each alternative in more detail, supporting the determinations made above. The BA also contains current habitat values and a map of the LAUs on the Forest.

While lynx may benefit from roadless areas due to less winter habitat disturbance and potential competition with other predators, this relationship has not been proven. Prey populations are likely of greatest importance for the lynx, and the Forest may lack enough

early seral stage (HSS 1 and 2) forested areas that provide higher densities of snowshoe hare, a primary prey species. Disturbances to create more of these conditions can arise from both natural (e.g., wildfire, insects) and management-related regeneration events (e.g., prescribed fire and timber harvest). While the emphasis on both these factors varies by alternative, vegetation modeling also shows that the forested covertypes will largely continue to become older with fewer young forests, barring any large wildfire events. The difference between alternatives is not significant enough to warrant different determinations in effects and viability outcomes based on these uncertainties. Large wildfire events will become increasingly likely as time progresses due to maturing stand conditions. This could possibly change the lack of young seral conditions, though this is not certain in the next planning period. It is estimated that a total of 15,000 acres of wildfire events could occur (22% chance) in the next planning period (10 – 20 years), changing habitat conditions. This estimate was not included in timber harvest modeling due to the uncertainties involved. However, even with this much disturbance in addition to the anticipated harvest under any alternative, the percent suitable habitat threshold would still not likely be reached due to the size of LAUs and the extent of mature stand conditions.

The Forest is not likely to receive substantial additional funding to implement the Healthy Forest Restoration Act, as other Regional priorities exist. Therefore, potential effects from this type of activity are deemed consistent with past programs in view of the determinations made above. The two LCAS standards and guidelines most noted for potential management conflict on the Bighorn National Forest have been the compacted snow activity direction, and the pre-commercial thinning direction, described in the following two paragraphs. Further disclosure of effects for these and other uses and resources occurs in the Northern Rockies Lynx Amendment DEIS.

There are no additional proposed groomed snowmobile trails or identified play areas in any of the alternatives. The Forest has not been approached with additional requests for these types of activities, and the State Trails program has indicated that there is no need for additional groomed routes. There have been minimal requests for additional outfitter/guide winter recreation activities that could compact snow for competing predators, and there would likely be a minimal potential for this in the future. These effects would likely be similar regardless of the application of the new Conservation Agreement (i.e. no conservation measures applied until lynx occur).

The effect of restricted thinning in young forests (another requirement that would not be applied until lynx occur) is uncertain. Thinning may reduce habitat for hares in some instances but can also prolong a higher density of lower branches and crowns that benefit hares and can more readily produce habitat for red squirrels. This management aspect is being researched, with possible resolution in the next planning period. Should lynx occur and management direction apply, the Forest estimates that the thinning precluded in LAUs would cause a delay in thinning of 10-20 years, depending on when the stands reach the required height. The Forest estimated that up to approximately 10,000 acres of thinning may be delayed in the next planning period due to this management direction, should lynx occur. Conversely, up to 10,000 acres of habitat may be thinned in the next period as well,

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if lynx do not occur. Approximately 95% of these acres would be in the dry lodgepole habitat type, which of less value for lynx, indicating minimal if any adverse effects to lynx over the forestwide scale. Should lynx occur, precluded thinning acres were not thought to be of significance over the forestwide scale, as other areas are available for thinning outside of LAUs, and budgets do not provide the opportunity to thin all of the suitable/available acres in one planning period. There may be slowed growth in the non-thinned stands. Currently, there would be no restriction on thinning until lynx are known to occur.

The Forest would continue to investigate lynx sighting reports. In addition, winter snow track surveys for carnivores as described in the Monitoring Plan may provide detections of this species should they occur. Annual monitoring of vegetation databases would also provide the indicators necessary to track the % suitable habitat and other habitat features on an annual basis.

As all alternatives examined in the Bighorn's FEIS would comply with the LCAS direction, should lynx occur, there is little difference in determinations by alternative based on habitat effects. While the Forest has been following LCAS management direction since 2000, it would not continue to do so until such time as lynx were determined to occur on the Forest. Even with the LCAS direction, little disruption occurred to projects being implemented due to regulatory requirements. Baseline suitable habitat (>70% suitable, >10% denning habitat) was retained when potential timber harvest was modeled for each alternative. Viability outcomes for lynx are speculative as population factors are difficult to consider due to a lack of distribution information. With the continuation of existing practices such as winter recreation, livestock grazing, and vegetation treatments that can affect potential habitat, a "no effect" determination was not warranted, and a "B" was used for viability outcomes. However, a cumulative viability outcome of IV was used, as there are not currently any lynx known on the Forest, though they are also highly mobile and may immigrate from other areas. Activities conducted on the Forest from prescribed burning, timber harvest, recreation use, etc. could potentially disrupt habitat or an individual, though the levels prescribed by any alternative would not likely have a significant effect on lynx or their habitat, whether or not the conservation measures were currently being followed. Therefore, a determination of "may affect, not likely to adversely affect" for the lynx was made. The determination in the DEIS of "likely to adversely affect" was changed, since that determination was based on using the preferred alternative management direction from the Northern Rockies amendment (E), which was not final. The Northern Rockies determination for that alternative in that DEIS was also for a "likely to adversely affect", so the Bighorn was matching that determination, based on a worst-case scenario approach.

In 2000, the Bighorn National Forest prepared a forestwide BA that addressed all known ongoing and proposed actions with regard to lynx management. There were no determinations of "likely to adversely affect" for any of the activities analyzed in 2000, and no outstanding mitigation measures were identified other than consideration of the measures in the LCAS. There has been little change from the conditions analyzed in this effort, nor would the habitat trajectory of alternatives produce a significant change from

the type or extent of activities analyzed in this effort. This rationale also supports a “not likely to adversely to affect determination” for this plan revision.

Cumulatively, there are no anticipated increases in highways or other barriers that could affect linkage routes adjacent to or within the Forest. Though timber harvest would occur on lands adjacent to the Forest, the level is not anticipated to affect linkage habitat or overall lynx habitat availability. The Forest likely provides the bulk of the lynx habitat in the Big Horn Mountains ecosection, and these factors resulted in a continuation of the current viability outcome (B) as the conservation measures for lynx would be adhered to. Mortality elements such as vehicle deaths and prey availability would continue to be factors determining population levels for this species. Predator control activities conducted in support of livestock grazing would continue to occur. There have been no mortalities of lynx on the Forest recorded with this type of activity, and due to changes made by USDA Wildlife Services in trapping methods, there is little likelihood that this activity would result in any mortality in the future.

Other Species

There are no anticipated effects from Forest activities on threatened, endangered, proposed and candidate species occurring in the plains adjacent to the Forest, and in downstream portions of the watersheds originating on the Forest. This is due to the difference in habitat types in the case of terrestrial species, and due to the known water quality (high) coming off the Forest for aquatic species. Prairie species potentially occurring adjacent to the Forest could include the black-footed ferret (E), and the Ute’s ladies’-tresses (T). Forest activities do not affect habitat for these species due to the distance from the Forest and no known cumulative effects from Forest management activities. The downstream aquatic species include the pallid sturgeon (E) in the Yellowstone River, with reintroduction proposals being considered in the lower Tongue River. Consultation with the USFWS for this species indicates no concern with regards to plan revision or Forest activities as no additional consumptive uses of water are being proposed on the Forest. This would also apply to any potential downstream populations of the Ute’s ladies tresses. The main issues for the sturgeon are the diversions and dams that occur a considerable distance from the Forest boundary.

AFFECTED ENVIRONMENT SENSITIVE SPECIES

Sensitive species are those plant and animal species whose population viability is a concern on National Forests within the Region. They may also be those species whose current populations and/or associated habitats are reduced or restricted, or their habitats and/or populations are considered vulnerable to various management activities, and special emphasis is needed to ensure they do not move towards listing as threatened or

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endangered. Sensitive species were selected by the Regional Forester according to criteria developed and information evaluated by a panel of Forest Service specialists (USDA 2003). It is known that many impacts to species may occur off of the National Forests, depending on a species' life history. Only those species known to occur or with the potential to occur on the Bighorn National Forest are included in this analysis, as indicated on the Regional Forester's list. Direction for sensitive species management comes from the FS Manual (2670).

A description of each species and what is known of the current and historical distribution of that species and its habitat on the Forest is included in the Species Assessments (see administrative record) and the Biological Evaluation (See Project Record). Known locations on the Forest were mapped on the Forest's GIS with assistance from the Wyoming Natural Diversity Database, Wyoming Game and Fish Department (WGFD), and others. The sighting records are included in the administrative record.

Two fish, three amphibians, six mammals, 15 birds, and 12 plant sensitive species are known to occur or are documented in the vicinity of the Bighorn National Forest and similar habitat occurs on the Forest. The following table lists the species, their known distribution or abundance on the Forest, and their associated habitats on the Forest.

Table 3-27. Bighorn National Forest sensitive species.

Common Name	Scientific Name	Habitat	Species Occurrence on Forest ³
Fish			
Yellowstone cutthroat trout	<i>Oncorhynchus clarki bouvieri</i>	Riverine	Known in limited streams.
Mountain Sucker	<i>Catostomus platyrhynchus</i>	Riverine	Known in the Tongue River drainage.
Amphibians			
Northern leopard frog	<i>Rana pipiens</i>	Ponds/Wetland/Riparian	Known in limited areas.
Columbia spotted frog	<i>Rana luteiventris</i>	Ponds/Wetland/Riparian	Known in limited areas.
Wood frog	<i>Rana sylvatica</i>	Ponds/Wetland/Riparian	Known in limited areas.
Mammals			
Fringed myotis	<i>Myotis thysanodes</i>	Caves/Mines & Forested areas	Known in limited sites.
Spotted bat	<i>Euderma maculatum</i>	Caves/Mines & Forested Areas	None known. Occurs in locations near the Forest. Potential habitat on the Forest.
Townsend's big-eared bat	<i>Corynorhinus townsendii</i>	Caves/Mines	Known in limited sites.

³ Number of known plant species occurrences as of May 2005.

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Common Name	Scientific Name	Habitat	Species Occurrence on Forest³
Water vole	<i>Microtus richardsoni</i>	Riparian	Known. Very limited in known distribution.
American marten	<i>Martes americana</i>	Late-successional conifer	Known in several areas.
Wolverine	<i>Gulo gulo</i>	Spruce-fir/ Alpine tundra	Historic/Potential with occasional sightings.
Birds			
Harlequin duck	<i>Histrionicus histrionicus</i>	Wetland/Lake	Historic/Potential; sighted nearby.
Northern harrier	<i>Circus cyaneus</i>	Grasslands/ Shrub-steppe	Known with many observations.
Northern goshawk	<i>Accipiter gentilis</i>	Mature conifer/aspen	Known with several observations.
Peregrine falcon	<i>Falco peregrinus anatum</i>	Canyons/Cliffs/ Riparian	Known, though sporadic. Historic nesting on the Forest.
Greater sage grouse	<i>Centrocercus urophasianus</i>	Sagebrush	No leks (breeding) on Forest. Late summer brood rearing primarily on west side of the Forest.
Flammulated owl	<i>Otus flammeolus</i>	Mature ponderosa/ aspen	None currently known on Forest. Occurs north of the Forest. Limited potential habitat on the Forest.
Short-eared owl	<i>Asio flammeus</i>	Grassland/Sage Steppe	Known, somewhat limited potential.
Boreal owl	<i>Aegolius funereus</i>	Mature Conifer	Known from limited sightings.
Lewis' woodpecker	<i>Melanerpes lewis</i>	Conifer/Riparian	Known from limited sightings.
Three-toed woodpecker	<i>Picoides tridactylus</i>	Mature Conifer	Known in several areas of the Forest.
Olive-sided flycatcher	<i>Contopus cooperi</i>	Mature Conifer	Known in several areas of the Forest.
Loggerhead shrike	<i>Lanius ludovicianus</i>	Grassland	Known on fringes of the Forest where meadows occur.
Brewer's sparrow	<i>Spizella breweri</i>	Sage steppe	Known in several areas of the Forest.
Sage sparrow	<i>Amphispiza bellii</i>	Sage steppe	None known on the Forest, but there is potential for occurrence.
Grasshopper sparrow	<i>Ammodramus savannarum</i>	Grasslands	Known from limited sightings.

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Common Name	Scientific Name	Habitat	Species Occurrence on Forest ³
Plants			
Leathery grapefern	<i>Botrychium multifidum</i>	Wet meadows and bottomlands	Known. 1 occurrence on the Forest
Mountain lady's slipper	<i>Cypripedium montanum</i>	Shady forests and riparian shrublands at mid-elevations.	Known. 4 occurrences on the Forest.
Yellow lady's slipper	<i>Cypripedium parviflorum</i>	Damp mossy forests, and streamsides at mid-elevations.	Known. 3 occurrences on the Forest.
Russet cotton-grass	<i>Eriophorum chamissonis</i>	Montane swamps and bogs.	Known. 3 occurrences on the Forest.
Hall's fescue	<i>Festuca hallii</i>	Montane meadows	Known. 1 vague historical (1898) record.
Grass-of-parnassus	<i>Parnassia kotzebuei</i>	Moist seeps.	Known. 1 occurrence on the Forest.
Cary beardtongue	<i>Penstemon caryi</i>	Disturbed areas on sedimentary soils.	Known. 14 occurrences on the Forest.
White larchleaf beardtongue	<i>Penstemon laricifolius</i> ssp. <i>exilifolius</i>	Rocky, calcareous hills, bare soils	Not known on the Forest. Occurs off-Forest near west boundary
Wooly twinpod	<i>Physaria didymocarpa</i> var. <i>lanata</i>	Rocky outcrops and rocky soil, without dense grass or shrub cover. Forested areas.	Known. 4 occurrences on the Forest.
Hairy tranquil golden-weed	<i>Pyrrocoma clementis</i> var. <i>villosa</i>	Sagebrush grasslands and montane meadows.	Known. 3 occurrences on the Forest.
Northern blackberry	<i>Rubus arcticus</i> ssp. <i>acaulis</i>	Riparian area along Sourdough Creek	Known. 1 occurrence on the Forest.
Lesser bladderpod	<i>Utricularia minor</i>	Submerged in ponds, slow moving streams	Known. 1 occurrence on the Forest.

ENVIRONMENTAL CONSEQUENCES

SENSITIVE SPECIES

Effects determinations are made for sensitive species similar to the determinations required for threatened and endangered species, and are documented in the Biological Evaluation (BE) (FEIS Appendix K). Effects determinations include “no impact” to the species, “may impact individuals or habitat, but not likely to lead to a trend toward federal listing”, “may impact individuals or habitat, likely to lead to a trend toward federal listing”, and “beneficial effect.” Requirements for Biological Evaluations and sensitive species in general are stated in FSM 2670. In addition to the standard determinations, viability outcomes for these species were made, as described previously. The following table summarizes the determinations made in the BE and the estimated viability outcomes. A summary of effects for the species follows the table.

Under all the alternatives, the determination for the sensitive species is predicted to be “may impact individuals or habitat but not lead to a trend toward federal listing.” This is due to the variety of factors that can influence a species, regardless of protective measures or other beneficial actions that are proposed. The main difference in viability outcomes between alternatives is tied to the risk of additional roading (including spread of noxious weeds and habitat fragmentation) that would be likely with implementation of Alternatives E and A. The risks for Alternatives A and E applies mainly to the species tied to mature conifer habitat. Snags and coarse woody debris may occur at reduced levels in Alternatives A and E compared to the other alternatives. Cumulatively, the short-term impact of diseases such as the West Nile virus on avian species is unknown.

The Yellowstone cutthroat trout (YCT) are of viability concern due largely to the limited distributions caused by past actions. These actions include the introduction of non-native species that either out-compete or dilute genetic integrity of YCT, habitat isolation from diversions and dams (largely off the Forest), and habitat degradation from past management of riparian areas (e.g., historic levels of livestock grazing, tie hacking). Due to their suppressed or small isolated populations, YCT on the Forest are at an increasing risk from catastrophic disturbances or diseases such as whirling disease. Genetic exchange among sub-populations is limited. With management towards improved watershed conditions and improved riparian habitat conditions across all alternatives, some of these past trends can be reversed. Coordination with WGFD would occur regarding non-native species interactions and attempts to improve current distribution of YCT (reintroduction, etc.). There are no management prescriptions that would necessarily benefit or detract from habitat for this species, as the standards and guidelines that provide habitat protection are forestwide. Therefore, there are few, if any, differences among alternatives considered, as the current impacts of dispersed recreation and livestock grazing would not likely vary by alternative significantly. There could be increased risk in additional roading (stream crossings, sediment potential), which would be greatest in Alternative E, and least in Alternative C, but design measures would provide for fish passage and minimize sediment. This is one of the species that is of greatest risk for continued viability due to these

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cumulative factors above, and populations have a chance of being reduced despite any improvement measures taken. Alternative D-FEIS provided several areas with YCT to use management prescription 5.4 that provides additional direction on maintaining a low number of stream crossings from roads in a given watershed, which was not in place in D-DEIS. The BE (FEIS Appendix K) provides an analysis of how management prescriptions were allocated by occupied habitat for YCT by alternative.

Table 3-28. Effects determinations for sensitive species occurring on the Bighorn National Forest by alternative.

Sensitive Species	Alt A	Alt B	Alt C	Alt D-DEIS and D-FEIS	Alt E
Yellowstone cutthroat trout	MIIH ⁴ V-C ⁵ CV-V ⁶	MIIH V-C CV-V	MIIH V-C CV-V	MIIH V-C CV-V	MIIH V-C CV-V
Mountain sucker	MIIH V-B CV-II	MIIH V-B CV-II	MIIH V-B CV-II	MIIH V-B CV-II	MIIH V-B CV-II
Northern leopard frog, Columbia spotted frog, Wood frog	MIIH V-C CV-IV	MIIH V-C CV-IV	MIIH V-C CV-IV	MIIH V-C CV-IV	MIIH V-C CV-IV
Fringed myotis, Spotted bat, Townsend's big-eared bat	MIIH V-B CV-II	MIIH V-B CV-II	MIIH V-B CV-II	MIIH V-B CV-II	MIIH V-B CV-II
Water vole	MIIH V-C CV-III	MIIH V-C CV-III	MIIH V-C CV-III	MIIH V-C CV-III	MIIH V-C CV-III
American marten, Wolverine	MIIH V-B CV-II	MIIH V-A CV-I	MIIH V-A CV-I	MIIH V-A CV-I	MIIH V-B CV-II
Harlequin duck	MIIH V-A CV-I	MIIH V-A CV-I	MIIH V-A CV-I	MIIH V-A CV-I	MIIH V-A CV-I

⁴ Effects Determinations from Biological Evaluation: NI = No Impact; MIIH = May impact individuals or habitat but not likely to cause a trend toward federal listing or loss of viability; LFL = May impact individuals or habitat, likely to result in a trend toward federal listing or loss of viability; BE = Beneficial effect.

⁵ Viability (V) Outcomes: Described in introduction to this Single Species assessment section. Range from A (stable), to E (high risk), thus the A – E ratings for those ecological conditions directly resulting from FS management of habitat.

⁶ Cumulative Viability (CV) Outcomes: Described in the introduction to this section. Range from I (stable) to V (high risk). These ratings include cumulative effects from adjoining lands or other influencing factors beyond the scope and control of the Forest Service.

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Sensitive Species	Alt A	Alt B	Alt C	Alt D-DEIS and D-FEIS	Alt E
Northern harrier	MIIH V-B CV-III	MIIH V-B CV-III	MIIH V-B CV-III	MIIH V-B CV-III	MIIH V-B CV-III
Northern goshawk	MIIH V-B CV-II	MIIH V-A CV-I	MIIH V-A CV-I	MIIH V-A CV-I	MIIH V-B CV-II
Peregrine falcon	MIIH V-A CV-I	MIIH V-A CV-I	MIIH V-A CV-I	MIIH V-A CV-I	MIIH V-A CV-I
Greater sage grouse, Short-eared owl	MIIH V-B CV-III	MIIH V-B CV-III	MIIH V-B CV-III	MIIH V-B CV-III	MIIH V-B CV-III
Flammulated owl, Boreal owl, Lewis' woodpecker, Three-toed woodpecker, Olive-sided flycatcher	MIIH V-B CV-II	MIIH V-A CV-I	MIIH V-A CV-I	MIIH V-A CV-I	MIIH V-B CV-II
Loggerhead shrike, Brewer's sparrow, Sage sparrow, Grasshopper sparrow	MIIH V-B CV-III	MIIH V-B CV-III	MIIH V-B CV-III	MIIH V-B CV-III	MIIH V-B CV-III
Mountain lady's slipper, Yellow lady's slipper, Cary beardtongue, White larchleaf beardtongue, Lesser bladderpod	MIIH V-B CV-II	MIIH V-B CV-II	MIIH V-B CV-II	MIIH V-B CV-II	MIIH V-B CV-II
Woolly twinpod	MIIH V-A CV-I	MIIH V-A CV-I	MIIH V-A CV-I	MIIH V-A CV-I	MIIH V-A CV-I
Leathery grapefern, Hall's fescue, Tranquil golden-weed, Russet cotton-grass, Northern blackberry	MIIH V-B CV-III	MIIH V-B CV-III	MIIH V-B CV-III	MIIH V-B CV-III	MIIH V-B CV-III
Grass-of-parnassus	MIIH V-C CV-III	MIIH V-C CV-III	MIIH V-C CV-III	MIIH V-C CV-III	MIIH V-C CV-III

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Mountain sucker were listed as a sensitive species largely due to impacts in other parts of its range. It is known to only the Tongue River drainage. It is considered a stable and common species in Wyoming and is not thought to have changed in its distribution on the Forest as a result of any habitat impacts, past or current. Habitat would remain similar across all alternatives.

All three sensitive amphibians (wood frog, northern leopard frog, and spotted frog) are considered of viability concern on the Forest. This outcome arises largely from the global declines in amphibians for uncertain reasons (climate, disease, etc.) and predation by the non-native fish. With the limited number of current populations, the amphibian species are at increased risk from any catastrophic events that could impact habitat or populations. It is not clear whether Forest Service actions are contributing to the decline of these species, though impacts to riparian habitats from livestock grazing and dispersed recreation may be a factor. Reductions from historic livestock numbers and improved management by applying standards and guidelines should minimize this risk. Management of livestock grazing does not vary by alternative. There are no predicted losses of any wetland habitat from planned activities, and forestwide standards and guidelines for the YCT would also apply for this species. Coordination with the WGFD would continue with regard to non-native species effects and any improvement efforts in amphibian distribution (reintroduction, etc.). With coordinated efforts to improve the presence of beaver (MIS) on the Forest, habitat for these species should continue to improve over time. Continued inventory and monitoring would occur for these species, as only approximately 50% of the Forest has been surveyed for them. Cumulatively, it is not thought that populations on the Forest have the opportunity to interact with other populations in the state based on the island nature of the Forest. Continued viability of these species is at risk due to these cumulative factors, which resulted in its low viability rating in the table above. Cumulative effects are limited to the Forest as there are few or no known occurrences of these species off the Forest in lands adjacent to it.

Water voles are at risk based on limited distribution. There may be more risk for this species than others with regard to riparian habitat conditions affected by livestock and wild ungulate grazing and recreational use. There would be little difference among alternatives with regard to this, and riparian conditions are likely to improve over time through application of livestock and recreation standards and guidelines for riparian areas. Continued inventory and monitoring would occur for this species. Cumulative effects are limited to the Forest, as there is thought to be no suitable habitat connecting populations on the Forest with those in other areas of the state. Sub-populations on the Forest may disperse to interact with others during wet years.

For bat species, the viability concern arises from the condition of cave habitats. The Forest has taken action to designate significant caves and will be preparing and implementing cave management plans for these species, possibly involving gating some caves. Recreational cave use is not predicted to vary between alternatives; however, recreation use and impacts from that use may continue to increase on the Forest. Forestwide direction would provide improvements for managing these habitats. Snags also provide roosting habitat for some of the bat species, and corresponding forestwide direction should

ensure the availability of this type of habitat. Potential snag habitat may be the greatest in Alternative C due to the amount of area dominated by natural processes and lowest in Alternative E due to increased management for timber production. Continued inventory and monitoring would occur for these species, and many areas have not been surveyed for determining presence or absence. As these species are migratory to some extent, it is not clear how habitat conditions in the rest of the state will influence populations on the Forest.

For species associated with old growth, coarse woody debris, and/or snags for at least part of their habitat requirements (marten, wolverine, flammulated owl, boreal owl, goshawk, woodpeckers, and flycatcher), refer to the previous discussion of these habitat types under ecosystem analysis. Revised Plan direction protecting these species would be applied regardless of alternative chosen, indicating a base level of viability protection. The management activities likely to reduce these types of habitat would be greatest in Alternative E and least in Alternative C. However, modeling indicated that mature conditions on the Forest would continue to dominate, and all alternatives would likely still provide habitat structure within the HRV. The effects of wildfire are somewhat unknown, other than a larger event (15,000 acres or greater) may likely to occur in the next planning period. The Forest currently estimates that it may have at least the minimum level of old growth as prescribed by the Revised Plan (10% and 15%), however the spatial location has not been surveyed. With implementation of the Revised Plan (strategies and guidelines), this resource should be maintained to meet the requirements, as indicated by timber model results. Spatially, it was not estimated where harvest activities would occur in the next planning period.

Marten are impacted by trapping, which is regulated by the WGFD. Trapping pressure could increase where roads are created into areas with marten habitat. Marten habitat modeling shows many areas of potential habitat, but there is limited information on their current distribution. They likely do not interact with populations off the Forest, but there is good potential for populations on the Forest to interact due largely to their dispersal ability.

Wolverines have most often been associated with areas managed for low occurrence of people, which could be greatest in Alternative C and least in Alternative E. A viability outcome determination for wolverines is difficult as they are not known to occur as residents, and therefore the determination is speculative. Due to their known ability to disperse across long distances, a population, should it occur on the Forest, would likely continue to have interaction with other populations in the state. Lynx conservation measures applied in this revision (the LCAS) may also benefit habitat requirements for martens and wolverines, though this would only apply if lynx were known to occur on the Forest.

Information about nest locations for the flammulated or boreal owl is lacking; effects to these species are speculative based on habitat in other known areas, and viability outcomes are also speculative. Lack of aspen or deteriorated condition of aspen as a source of cavities for nesting for both of these species is a concern. Goshawks are often more associated with an open understory under a mature canopy, and no effect from past management disturbances has been observed in known nest locations. In areas where

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mature conditions are not replaced through widespread disturbance events, active management for structural stage diversity may play a role in providing habitat through time. Active management for structural stage diversity would likely be greatest in Alternative E and lowest in C, though anticipated changes from wildfire are not considered in these predictions. Risk of altered habitat from increased harvest activity may also take place, however. This would be greatest in Alternatives E and A, least in C and B.

Three-toed and Lewis' woodpeckers would likely thrive where insects and disease occurred. This potential may be greatest in Alternative C which has the greatest emphasis on natural processes, less in Alternatives B, D-DEIS and D-FEIS, and least in Alternatives A and E respectively. Similarly, olive-sided flycatchers may do best where snags have the most potential to occur, following similar trends as the woodpeckers. Flycatchers are migratory, and would be more susceptible to cumulative effects on winter ranges.

Inventory and monitoring would continue for all old growth associated species. Cumulative effects for these species are largely limited to the Forest in terms of habitat, as the Forest provides most of the conifer habitat in the ecosection. All of these species may migrate off of the Forest or to it, with potential genetic interaction with other populations in the state.

With regard to the Brewer's sparrow, sage sparrow, and sage grouse, the Forest would continue actively managing the sagebrush habitats, primarily through prescribed fire, in an effort to restore more historic conditions: diverse canopy covers and densities and diverse understory vegetation. While this may cause a temporary displacement of some species' use of the older patches, this action should have long-term benefits due to the creation of diversity in shrub age classes. There may be some reduced risk of widespread wildfires which are more likely to create primarily young conditions and opportunities for noxious weed expansion over larger acreages. Active management of these habitats would likely occur most in Alternatives A, B, D-DEIS and D-FEIS, and E, but least in Alternative C. Under all alternatives, protection measures such as application of grouse management guidelines (Connelley 2000) and monitoring practices would occur. As it is not known if the sage sparrow occurs on the Forest, viability outcomes for this species are largely speculative. All three species spend a considerable portion of their life off Forest and would be affected by cumulative effects in those areas, including habitat conversions to cheatgrass or habitat loss from wildfire and noxious weeds.

The harlequin duck is a riparian-associated avian species. There are no anticipated impacts to these habitats, and the protection measures for these habitats and this species are forestwide, regardless of alternative. As there are no known occurrences of this species currently on the Forest, viability outcomes were speculative. Recreation disturbances would likely be the main potential impact. Reservoirs construction, over time, may have reduced potential habitat for this species. Impacts from off Forest may currently be limiting the expansion of this species onto the Forest. There have only been sporadic observations in the Forest in past times, indicating a lack of use of the Forest for primary habitat, as Wyoming is at the southern end of its range.

Effects to species associated with grasslands (harrier, short-eared owl, loggerhead shrike, grasshopper sparrow) are tied largely to livestock grazing management and recreation. Neither activity varies by alternative therefore the effects to these species would be similar between alternatives. Application of standards and guidelines for rangeland vegetation should continue to provide habitat for these species, with potential improvements over time. Continued inventory and monitoring would occur for these species. The Forest provides less of this type of habitat than the surrounding plains, and it is largely a stable type of habitat on the Forest due to soil conditions. Cumulative effects off Forest on adjacent lands are likely more important than any effects on the Forest. Shooting or poor rangeland conditions are likely the main threats in their range.

The peregrine falcon would not likely be affected differently by any of the alternatives, as its habitat is largely secure in cliffs. Some recreation disturbance may occur, though this would likely be similar among all alternatives. Nest protection measures would apply regardless of alternative selected. Improved trends in this species are largely from halting use of DDT throughout its range, and reintroduction efforts by private and state agencies. Continued inventory and monitoring would occur for this species in coordination with the WGFD.

All of the plant species are known to few locations, and are thus at some risk from a viability aspect with regard to catastrophic events (fire, flood, etc.). Their ability to persist through seed or other dispersal mechanisms is largely unknown, though their presence indicates their adaptability to the ecosystems of the Forest given these types of events. Risks are relatively low from any management-related activity. Protection measures in the Revised Plan (spatial buffers, etc.) would apply across all alternatives, and a difference in effects among alternatives is not anticipated. Project planning includes site-specific surveys and documentation in a BE, which would include needed mitigation. Some of the plants have known locations in potential RNAs, which would not be as protected in Alternative E. The opportunity for impacts from noxious weeds may similarly be greatest in Alternatives A and E due to the increased amount of roading; Alternative C would have the least potential for noxious weed impacts. Throughout the Forest, the potential for recreational activities to introduce weeds would likely remain high in all alternatives. Treatment for noxious weeds would continue similarly from all alternatives, and the current threat to sensitive plant populations from noxious weeds is unknown. Most plant populations are in remote locations due to unique habitat associations and, as such, are largely protected from potential management activities. Livestock grazing has the potential to impact some aquatic, grassland, or shrub-associated species, and these same habitat types are the most likely areas for noxious weed expansion, though primarily at lower elevations. Many species are sensitive based on limited information about their distribution. Continued inventory and monitoring will occur for these species as outlined in the Monitoring Plan.

AFFECTED ENVIRONMENT SPECIES OF LOCAL CONCERN

In addition to Region 2 sensitive species, each Forest may assess species of “local concern.” These species may be doing well on other administrative units or states but are less successful locally and in need of management attention. Local endemics, even if not known to be at risk, may be worth additional analysis if the population size is small and/or isolation makes the populations vulnerable. Most of the species were selected because of a lack of information about distribution or presence/absence on the Forest. This is true of the plants selected. Rationale for selection of local concern species occurs within the Emphasis Species Categories document (on file in the administrative record). Individual species assessments were prepared with information on habitat and populations on the Forest. In total, three mammals, nine birds, and 26 plants were identified (see following table).

Table 3-29. Species of local concern on Bighorn National Forest.

Common Name	Scientific Name	Habitat	Species Occurrence on Forest
Mammals			
Long-eared myotis	<i>Myotis evotis</i>	Caves/Mines	Known, but on limited sites.
Hoary bat	<i>Lasiurus cinereus</i>	Aspen/Conifer Snags	None known, but there is potential habitat. Due to lack of aspen on Forest, may be less potential than other areas of state where known to occur.
Rocky Mountain bighorn sheep	<i>Ovis canadensis</i>	Rock/ Alpine meadow	Historic forestwide. Currently in Shell Cr. watershed with <30 animals.
Birds			
Common loon	<i>Gavia immer</i>	Wetland/Lake	Known observations, but no known breeding.
Swainson’s hawk	<i>Buteo swainsoni</i>	Grassland/Riparian	Known to few areas.
Great gray owl	<i>Strix nebulosa</i>	Mature Conifer	Suspected occurrence and potential habitat.
Pygmy nuthatch	<i>Sitta pygmaea</i>	Mature Conifer	Known; limited sightings.
Calliope hummingbird	<i>Stellula calliope</i>	Conifer/Riparian	One known occurrence.
Golden-crowned kinglet	<i>Regulus satrapa</i>	Spruce-fir	Known; limited occurrences.

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Common Name	Scientific Name	Habitat	Species Occurrence on Forest
Plants			
Musk root	<i>Adoxa moschatellina</i>	Shady, moist, moss-rich limestone cliffs	Known. 2 locations, 1 in Leigh Cr. potential RNA
Aromatic pussytoes	<i>Antennaria aromatica</i>	Open slopes/ridges, limestone talus at or above timberline	Known. 1 location.
Pygmy pussytoes	<i>Antennaria monocephala</i>	Wind swept, open slopes, ridges in alpine or subalpine tundra	Known. 1 location in Cloud Peak Wilderness.
Upward lobed moonwort	<i>Botrychium ascendens</i>	Hummocky marshes and bogs	Known. 1 occurrence on Forest.
Lance-leaved grapefern	<i>Botrychium lanceolatum</i>	Riparian areas, organic rich hummocks	Known –one occurrence.
Mingan moonwort	<i>Botrychium minganense</i>	Wide variety: riparian, moist meadows, sand dunes, prairies, woods.	Known. 2 occurrences, 1 in Mann Cr. potential RNA
Rattlesnake fern	<i>Botrychium virginianum</i>	Calcium rich, moist shady areas	Known. 1 occurrence in Mann Cr. potential RNA
Mud sedge	<i>Carex limosa</i>	Wetlands, often limey	Known. 1 occurrence on Forest.
Short-leaved sedge	<i>Carex misandra</i>	Alpine wet meadows, willows, streambanks	Known. 1 occurrence in McClain potential RNA
Leafy thistle	<i>Cirsium foliosum</i>	Moist areas along roads, meadows, slopes	Known. 1 occurrence.
Fragile rockbrake	<i>Cryptogramma stelleri</i>	Moist wooded slopes and limestone cliffs	Known. 1 occurrence in Cloud Peak Wilderness
White arctic whitlow-grass	<i>Draba fladnizensis</i> var. <i>pattersonii</i>	Fellfields and talus slopes above 1000 feet	Known. 2 occurrences in Cloud Peak Wilderness
Woodland horsetail	<i>Equisetum sylvaticum</i>	Preacher Rock Bog - riparian	Known. 1 occurrence on Forest.
Low fleabane	<i>Erigeron humilis</i>	Granite and limestone cliff faces on moist mossy microsites	Known. 1 occurrence in Cloud Peak Wilderness.
Howard forget-me-not	<i>Eritrichium howardii</i>	Limestone outcrops and dry rocky areas	Known. 1 occurrence on Forest.
Three-flower rush	<i>Juncus triglumis</i> var. <i>triglumis</i>	Wet gravel slopes below melting snows	Known. 1 occurrence in Cloud Peak Wilderness.

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Common Name	Scientific Name	Habitat	Species Occurrence on Forest
Watson's prickly-phlox	<i>Leptodactylon watsonii</i>	Dry ledges on sedimentary cliffs.	Known. 1 occurrence on Forest.
Northern twayblade	<i>Listera borealis</i>	Moist, shady spruce forests.	Known. 2 locations on Forest.
Broad-leaved twayblade	<i>Listera convallarioides</i>	Moist, shady spruce forests.	Known. 1 occurrence on Forest.
Sheathed musineon	<i>Musineon vaginatum</i>	Limestone outcrops, chugwater redbeds	Known. 6 occurrences on Forest.
Alpine poppy	<i>Papaver kluanense</i>	Alpine meadows, talus slopes and fellfields	Known. 1 occurrence in Cloud Peak Wilderness plus additional unconfirmed reports.
Mountain lousewort	<i>Pedicularis pulchella</i>	Alpine meadows and alpine scree slopes	Known. 2 occurrences in Cloud Peak Wilderness.
Large-leaved pondweed	<i>Potamogeton amplifolius</i>	Lakes and slow moving streams	Known. 1 occurrence in Cloud Peak Wilderness.
Wooly prince's plume	<i>Stanleya tomentosa</i> var. <i>tomentosa</i>	Limber pine woodlands, juniper shrublands on limey-sandstone ridges, dry dolomite cliffs/talus	Known. 1 occurrence near Shell Canyon RNA.
Hapeman sullivantia	<i>Sullivantia hapemannii</i> var. <i>hapemanii</i>	Limestone outcrops and boulders in shaded streams	Known. 14 occurrences on Forest. Very protected habitat.
Soft aster	<i>Symphyotrichum molle</i>	Rocky calcareous soils in sagebrush or cinquefoil grasslands bordered by forests.	Known. Over 36 occurrences. Low priority for further inventory and monitoring due to increased known distribution and lack of threats.

Bat species were selected based on state heritage rankings showing rarity or concern, coupled with possible management activities in their habitats. Bighorn sheep were selected due to past historic occurrence and struggling populations currently. Disease interactions with domestic livestock (sheep) are likely the issue, though the issue is complicated by similar interaction potentials on adjoining private land where bighorn sheep winter.

Bird species selected were largely due to lack of information on occurrence, and yet state heritage rankings were of sufficient concern to justify inclusion since management activities can occur in their potential habitat.

Plant species were selected to help prioritize inventory efforts over the next planning period, though most selected were not due to management related threats.

ENVIRONMENTAL CONSEQUENCES

SPECIES OF LOCAL CONCERN

As a Biological Evaluation was not required for local concern species, effects to these species were addressed through the viability process document contained in the administrative record, according to the habitat type with which they are associated. There were no determinations made as required for the sensitive species. However, viability outcomes were assessed for each species, though this is largely speculative based on the lack of population information for most of the species. Viability outcomes were previously described in the introduction of the single species assessment. The following table summarizes the viability outcomes and includes those attributable to Forest Service management activities tied to alternatives and cumulative effects (CV). A summary of effects for the species follows the table.

Table 3-30. Viability outcomes for species of local concern on the Bighorn National Forest by alternative.

Species of Local Concern	Alt A	Alt B	Alt C	Alt D-DEIS and D-FEIS	Alt E
Long-eared myotis	V-B ⁷ CV-II ⁸	V-B CV-II	V-B CV-II	V-B CV-II	V-B CV-II
Hoary bat	V-B CV-II	V-A CV-I	V-A CV-I	V-A CV-I	V-B CV-II
Bighorn sheep	V-C CV-V	V-C CV-V	V-C CV-V	V-C CV-V	V-C CV-V
Common loon	V-A CV-I	V-A CV-I	V-A CV-I	V-A CV-I	V-A CV-I
Swainson's hawk	V-B CV-III	V-B CV-III	V-B CV-III	V-B CV-III	V-B CV-III
Great gray owl, Pygmy nuthatch, Calliope hummingbird, Golden-crowned kinglet	V-B CV-II	V-A CV-I	V-A CV-I	V-A CV-I	V-B CV-II

⁷ Viability (V) Outcomes: Described in introduction to this Single Species assessment section. Range from A (stable), to E (high risk), thus the A – E ratings for those ecological conditions resulting from FS management of habitat.

⁸ Cumulative Viability (CV) Outcomes: Described in the introduction to this section. Range from I (stable) to V (high risk). These ratings include cumulative effects from adjoining lands or other influencing factors beyond the scope and control of the Forest Service.

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Species of Local Concern	Alt A	Alt B	Alt C	Alt D-DEIS and D-FEIS	Alt E
Musk root, Pygmy pussytoes, Mud sedge, Short-leaved sedge, Leafy thistle, Howard forget-me-not, Fragile rockbrake, Sheathed musineon, Upward lobed moonwort, Lance-leaved grapefern, Mingan moonwort, Rattlesnake fern, Woodland horsetail, Alpine poppy, Mountain lousewort, Large-leaved pondweed	V-B CV-II	V-B CV-II	V-B CV-II	V-B CV-II	V-B CV-II
White arctic whitlow-grass, Low fleabane, Hapeman sullivantia, Soft aster	V-A CV-I	V-A CV-I	V-A CV-I	V-A CV-I	V-A CV-I
Aromatic pussytoes, Watson's prickly-phlox, Three-flower rush	V-C CV-III	V-C CV-III	V-C CV-III	V-C CV-III	V-C CV-III
Northern twayblade, Broad-leaved twayblade, Hairy prince's plume	V-B CV-III	V-B CV-III	V-B CV-III	V-B CV-III	V-B CV-III

Effects to species of local concern were addressed by habitat group association in the viability process document in the administrative record. The rationale for the outcomes in the previous table are summarized below.

The effects to the bat species would be similar to those described for sensitive bat species previously, with the exception that hoary bats are known to occur more in forested areas and use snags. Therefore, there may be a higher risk in alternatives where the greatest management of forested treatments occurs (E and A). They may preferentially use aspen, due to the larger number of cavities or prey associations. Due to their migratory status, cumulative effects are more speculative.

Bighorn sheep have not had a viable population on the Forest since the early 1900s, despite several reintroductions from the 1940s through 1990s. The few sheep remaining from those reintroductions, likely less than 12, would not likely expand into a viable population (considered to be 125 animals). This is largely due to continued interaction with domestic

sheep on and off the Forest where disease is transmitted to the Bighorn National Forest. Even if domestic sheep were removed from the Forest (refer to the Alternatives Considered but Not Analyzed In Detail section in FEIS Chapter 2), the bighorn sheep could still interact with domestic sheep on their winter range as this involves cumulative effects from private lands off the Forest where domestic sheep occur.

The Revised Plan contains conservation measures to benefit bighorn sheep, particularly within the Shell Creek watershed where bighorn sheep are currently known to persist. The Revised Plan has a guideline to evaluate opportunities to improve bighorn sheep management, including those covered in Woolever and Schommer (2001), when conducting Allotment Management Plan analysis. Due to the presence of domestic sheep, the WGFD has not made the Forest a priority for reintroduction, as the past reintroduction effort of 1994 was unsuccessful. The Forest Service and the WGFD have identified priority recovery sites in Wyoming and have implemented actions toward those recovery goals; the Bighorn National Forest has taken an active role in these recovery efforts. The Forest is currently considered a “non-emphasis” management area for bighorn sheep and is not a priority recovery site. The Forest has accepted domestic sheep most recently from the Shoshone National Forest in an effort to improve the bighorn sheep herd there as part of the interagency recovery efforts. There would be no difference among alternatives with regard to management for bighorn sheep, as conservation measures apply forestwide. Habitat remains in good condition on the Forest, but the potential for disease likely limits its value.

The effects to the common loon would be similar to those previously described for the harlequin duck (see the Sensitive Species section). The effects to the avian species associated with mature conifer, old growth, snags, or coarse woody debris (great gray owl, pygmy nuthatch, golden-crowned kinglet, calliope hummingbird) would also be similar to the effects described for the sensitive species linked to this type of habitat.

The effects to grassland avian species (Swainson’s hawk) would be similar to those described for the sensitive grassland avian species (harrier, short-eared owl). This species is highly migratory and has been suffering cumulative effects on its winter range.

Effects to the plant species of concern would be similar to those described for the sensitive plant species previously. In addition to the species of local concern, plant demand species were listed in the Revised Plan and include sweetgrass and purple coneflower. Sweetgrass is known to occur on the Forest and is collected by Americans Indians for ceremonial purposes. This plant may be in decline due to this factor and other habitat related factors, though details are unknown. Purple coneflower is not currently known to occur on the Forest, but is known adjacent to it. It is collected for its medicinal values. Designation as demand species will provide emphasis for inventory and monitoring and assessing habitat and collection related effects. The Forest can regulate collection of plant materials through a permit process should the effects deem this necessary.

Summary of Environmental Consequences

In summarizing the effects of the alternatives, the following table provides the number of species viability outcomes by each alternative taken from the non-cumulative effects tables, for all species at risk.

Table 3-31. Summary of species viability outcomes by alternative, from anticipated Forest management activities.

Alternative	Outcome A (# Species)	Outcome B (# Species)	Outcome C (# Species)	Outcome D (# Species)	Outcome E (# Species)
Alt A	9	57	10	0	0
Alt E	9	57	10	0	0
Alt B	23	43	10	0	0
Alt C	23	43	10	0	0
Alt D-DEIS and D-FEIS	23	43	10	0	0

In general, due to the risks associated with roads, alternatives with an increased level of roading over current levels carry more risk for most species, either due to habitat lost, additional disturbance from people, dispersal of noxious weeds, and to a lesser extent, fragmentation issues. However, under Alternative E (maximum timber harvest alternative), activities over time would be scheduled on less than 30% of the forested acres on the Forest, tempering these potential effects. Alternative C would be at the other end of the spectrum, scheduling harvest activities on approximately 7% of the forested acres within the Forest. None of these risks would be likely to lead toward a trend in federal listing or loss of viability for any of the sensitive species, and updated forest plan direction in standards and guidelines would provide a level of protection for these species across all alternatives. The direction to survey for species, design projects to promote habitat, and mitigate potential concerns from management activities such as through spatial or temporal buffers would provide baseline levels of protection for these species. With the baseline of goals, objectives, standards, and guidelines in the Revised Plan, all alternatives provide for the viability of species, some with more risk associated, but also with differing approaches in terms of the level of natural disturbance processes used vs. management induced processes, primarily in terms of vegetative manipulation.

Fire and Fuels Management

Introduction

The Bighorn National Forest fire management program has two broad purposes:

- ◆ To protect and enhance resources through wildfire prevention, fuel treatment, prescribed fire, and implementation of the appropriate management response to all wildland ignitions.
- ◆ To meet Forest management goals and objectives through the use of prescribed fire and the management of natural fires.

Although a variety of natural disturbances occur in the Rocky Mountains, fire is the predominant one. Fire has shaped the vegetation mosaic for thousands of years by causing a variety of scales of disturbances (Meyer and Knight 2001). Fire is also thought to have been a major disturbance agent for the Big Horn Mountains. Fire has a significant role in the various ecosystems on the Bighorn National Forest and has a major influence on structure, density, species composition, and age of shrub and forest vegetation. An accurate and detailed description of “natural” fire regimes is difficult because detailed fire histories are lacking for the Big Horn Mountains. Searches of historical literature have resulted in known fires prior to 1910, however, exact locations and sizes have not been ascertained. In addition, there are historical references indicating that large portions of the Big Horn Mountains were burned in the 1870s, although locations and acreages are not known.

The use of prescribed fire has been practiced on the Forest since the 1970s. These fires have primarily been used for fuels reduction and to improve or enhance habitat for wildlife and range for domestic livestock. Acres burned annually have varied significantly, but most recently have averaged about 2,600 acres. Most of the burns have been conducted in sagebrush/grass areas with a minor amount of burning within conifer stands. Prescribed fire has also been commonly used to reduce activity fuels following timber harvest.

The current Bighorn National Forest Land and Resource Management Plan (1985 Forest Plan) does not allow for implementation of wildland fire use (managing natural ignitions to meet resource objectives). After the signing of the Record of Decision (ROD) for this forest plan revision, the Bighorn Fire Management Plan will be updated to address opportunities for wildland fire use/appropriate management response across the Forest. The ROD is the decision document for the appropriate management response designations and the Fire Management Plan is the implementation document.

Currently, all wildland fires receive an immediate initial attack response. Cody Interagency Dispatch Center (CDC), located in Cody, Wyoming, serves the Forest through dispatch for initial attack, resources for extended attack, and large fire support.

Legal and Administrative Framework

The Organic Administration Act – June 4, 1897 (U.S.C.551): Authorizes the Secretary of Agriculture to make provisions for the protection of national forests against destruction by fire.

The Economy Act of 1932 – June 30, 1932 (41 U.S.C. 686): Provides for the procurement of materials, supplies, equipment, work, or services from other federal agencies.

The Reciprocal Fire Protection Act – May 27, 1955 (42 U.S.C. 1856): Authorizes reciprocal agreements with federal, state, and other wildland fire protection organizations.

The Wilderness Act – September 3, 1964 (16 U.S.C. 1131, 1132): Authorizes the Secretary of Agriculture to take such measures as may be necessary in the control of fire within designated wilderness.

The National Forest Management Act of 1976 – October 22, 1976 (16 U.S.C. 1600): Directs the Secretary of Agriculture to specify guidelines for land management plans to ensure protection of forest resources.

The Clean Air Act of 1977 (42 U.S.C. 1857): Provides for the protection and enhancement of the nation's air resources.

The Healthy Forests Restoration Act – December 3, 2003 (16 U.S.C. 6501). This act improves the capability of the Secretary of Agriculture and the Secretary of Interior to conduct hazardous fuels reduction projects across the landscape on National Forest lands and Park Service Agency lands.

The Tribal Forest Protection Act – 2004 (P.L. 108). This act authorizes the Secretary of Agriculture (with respect to land under the jurisdiction of the Forest Service) to carry out a project to protect Indian forest land or rangeland (including a project to restore Federal land that borders on or is adjacent to such land) under the Secretary's jurisdiction and bordering or adjacent to the Indian forest land or rangeland under the Indian tribe's jurisdiction.

The National Forest Directives System (Manuals, Handbooks and their current amendments) outlines the administrative framework for fire management activities, which includes protecting resources and other values from wildfire and using prescribed fire to meet land and resource management goals and objectives. The framework in these manuals and handbooks provides for cost-efficient wildfire protection and embraces the positive roles that fire plays on National Forest lands. Specifically, fire management guidance can be found in Forest Service Manual 5100, chapters 10 through 90, and Forest Service Handbooks 5109.14, 5109.17, 5109.18, and their subsequent amendments.

Other publications include *The Wildland and Prescribed Fire Management Policy: Implementation Procedures Reference Guide* (and its January 2001 update), *Wildland Fire Use Implementation Procedures Guide* (May, 2005), and the National Fire Plan. The first publication represents an effort by federal wildland fire management agencies to establish standardized procedures to guide immediate implementation of the policy described by the 1995 Federal Wildland Fire Management Policy and Program Review; it is used by the Forest Service as a guidance document. The National Fire Plan places an emphasis on protecting people and sustaining resources in fire-adapted ecosystems.

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Fire Regimes and Condition Class

A fire regime is a generalized description of the role fire plays in an ecosystem. Systems for describing fire regimes may be based on the characteristics of the disturbance, the dominant or potential vegetation of the ecosystem in which ecological effects are being summarized, or fire severity based on the effects of the fire on dominant vegetation (Agee 1993).

Vegetation on the Bighorn National Forest has been categorized into five fire regimes. These fire regimes have been quantified and described by the method used in the National Fire Plan (USDA Forest Service 2000) and are consistent with Fire and Land Management Planning Across Multiple Scales (Hann and Bunnell, 2001). This method groups cover types by a combination of fire frequency (expressed in terms of fire return intervals) and fire severity (intensity). Fire frequency is determined by ignition sources and burning conditions (primarily fuel moisture and wind). *Intensity* and *severity* are commonly used interchangeably; however, intensity is more an indicator of resistance to control and severity is a measure of ecological impact (i.e. tree mortality, impact to organisms, etc.). The following table displays the fire regime groups with associated cover types, fire return interval, and fire severity for the Bighorn National Forest. The fire return intervals and burn severity displayed for the various fire regimes/cover types are what would “historically” be expected; for example, a ponderosa pine stand historically would be expected to burn at relatively frequent intervals (less than 35 years) with a low surface fire intensity or understory burn (i.e. high frequency, low severity fire regime).

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Table 3-32. Fire regime groups with associated primary cover type, frequency, and severity.

Fire Regime Group	Primary Cover Type	Fire Return Interval (Frequency)	Burn Severity
1	Ponderosa pine (Cottonwood)	0-35 years	Low/Understory Burn
2	Sagebrush Grass/forb (Willow)	10-70 years	High/Stand Replacement
3	Limber pine Douglas fir Rocky Mountain juniper	35-100+ years	Mixed Severity/Understory and Stand Replacement
4	Lodgepole pine	70-100+ years	High/Stand Replacement
5	Engleman spruce Subalpine fir Aspen	Over 150 years	High/Stand Replacement
No Fire	Bare soil, rock & water	N/A	N/A

Fire Regime 1 is a fire-maintained ecosystem as characterized by high frequency of low intensity (severity) fire. In a fire-maintained ecosystem, frequent low intensity fires reduce the incidence of destructive wildfires through thinning, pruning, and removal of dead and down fuels. Fire Regimes 2, 4, and 5 are fire-initiated ecosystems in which severe or high intensity fires will terminate the resident vegetation and initiate a vegetation response (i.e., stand replacement). Fire Regime 3 will burn with mixed severity (both low intensity and high intensity) depending on site-specific conditions.

Within the fire regimes described for the Bighorn National Forest, the following dominant cover species respond to fire occurrence and severity in a variety of ways (adapted from Fire Effects Information System, 2002). In the information presented below, severity describes the product of fire intensity and fire residence time.

Ponderosa pine (*Pinus ponderosa* var. *scopulorum*): Interior ponderosa pine is rated “very resistant” to fire. Mature trees are well adapted to survive surface fires due to thick bark which protects the cambium layer⁹, self pruning branches, open crowns which are usually elevated well above the flame zone avoiding excessive scorch, and deep rooting. Mature ponderosa pine cannot survive crown fires, but can survive considerable crown scorching. Surface fires often kill seedlings and saplings (trees less than 3 to 5 years of age or less than 6 inches diameter breast height), however, the effect is dependent on stand structure and fire intensity. Young trees in open stands develop fire-resistant traits rapidly, while those in dense stands tend to develop thinner bark and denser foliage, which makes them less resistant to surface fires and

⁹ The cambium is a layer of living, meristematic cells between the wood and inner most bark of a tree. The cambium allows for fluid and nutrient movement between the roots and leaves of the tree. The cambium layer of thin-barked tree species is easily damaged by heat from fire.

more prone to crown fires. Mature trees in open stands with light fuels and sparse understory are less vulnerable to mortality from fire than those in dense stands. Heavy accumulations of litter increase the intensity and duration of fires, making the trees more susceptible to mortality and scarring. Fire prepares favorable seedbeds for regeneration.

Wyoming big sagebrush (*Artemisia tridentata* ssp. *Wyomingensis*): Although Wyoming big sagebrush ignites readily and burns intensely, this fuel type is dependent on moderate wind speeds to move the fire through the shrub layer. At lower wind speeds, the fire will drop to the ground. Fires in Wyoming big sagebrush on the Bighorn National Forest typically are not continuous, creating a mosaic burn pattern in which seeds from surviving plants are the principal means of post fire reproduction. Wyoming big sagebrush is slow to re-establish after a burn and frequent fire may inhibit re-establishment. Some sites in southern Idaho that have burned 2 to 3 times within 10 years are not regenerating Wyoming big sagebrush and are converting to annual grasslands.

Mountain big sagebrush (*Artemisia tridentata* ssp. *Vaseyana*): Mountain big sagebrush is readily killed by fire and will not resprout. Regeneration is from seed produced by on-site or off-site surviving plants, requiring at least 15 years to recover after fire.

Limber pine (*Pinus flexilis*): The bark at the base of older limber pine trees is up to 2 inches thick, which protects these trees from low severity surface fires. However, the bark of young trees is very thin making them very susceptible to mortality from low severity fires. Terminal buds are protected from crown scorch because the needles form tight clusters around the buds. As with ponderosa pine, mature trees in open grown stands are less susceptible to mortality from fire. Wildfires are less frequent in limber pine communities than in other conifer habitats because of limited productivity and fuel accumulation associated with poor soil development, short growing seasons, and late snowmelt. Where limber pine grows in association with other trees, the fire regimes of the other species are relevant.

Rocky Mountain Douglas-fir (*Pseudotsuga menziesii* var. *glauca*): Sapling and pole stages of Rocky Mountain Douglas-fir are susceptible to fire damage due to thin and resin-filled bark. Young trees also generally characterized by low branching, which allows surface fires to transition into the crowns. Mature trees can survive moderately severe surface fires because the bark on the lower bole is thick and corky, providing good insulation of the cambium from heat damage. Fire resistance provided by thick bark in mature trees is off-set by the fact that the trees tend to retain low branching even after the lower branches have shaded out and died. This lower branching serves as a ladder for surface fire to transition into the crowns.

Rocky Mountain juniper (*Juniperus scopulorum*): Due to thin bark and compact crown, Rocky Mountain juniper, up to 4 feet tall are easily killed by fire and because this species is slow-growing, they are susceptible to fire for their first 20 years or more. Mature trees develop thicker bark and more open crowns allowing them to survive surface fires if low branches do not carry fire into the crown. Highly volatile oil content in lower branches increases the flammability of the trees. Horizontal fuel continuity tends to be low in these fuel types, so crown fires are usually confined to small areas unless influenced by a strong wind event or extreme drought. Fire is the major factor controlling Rocky Mountain juniper. In general, this

tree grows on sites that do not burn frequently, such as rocky areas. Post fire re-establishment is by seed with animal transport of seed being an important factor.

Lodgepole pine (*Pinus contorta* var. *latifolia*): The thin bark of the lodgepole pine provides little insulation to the cambium layer making the tree susceptible to mortality from surface fires. Low severity surface fires tend to provide natural thinning of lodgepole pine stands since some trees will survive the fires. Closed-cones and open-cones occur in most stands of lodgepole pine in the Rocky Mountain area. The closed or serotinous cones will open after intense fires to reseed the area. Low severity surface fires do not generate enough heat to open serotinous cones, so regeneration is dependent on open cones. Thus, lodgepole pine is adapted to regenerate after both high severity and low severity fires.

Engelmann spruce (*Picea engelmannii*): Engelmann spruce is very fire sensitive and is often killed even by low-severity surface fires. This susceptibility to fire is due to thin bark which provides little insulation for the tree's cambium layer, resin in the bark which readily ignites, shallow roots which are subject to soil heating, low-growing branches with moderately flammable foliage that can readily transition surface fire into the crown, tendency to grow in dense stands, and presence of heavy lichen growth. While some of the larger Engelmann spruce may survive surface fires, they often will die later as a result of infection from wood-rotting fungi that enter the tree through fire scars. Post-fire regeneration occurs via wind-dispersed seeds from surviving or adjacent trees.

Subalpine fir (*Abies lasiocarpa*): Subalpine fir is very fire sensitive and is often killed by low-severity surface fires. Its susceptibility to fire is due to the same factors described above for Engelmann spruce. The discontinuous, broken fuels and moist, cool environment of subalpine fir habitat often allows scattered trees to escape mortality from fires. Dense stands are susceptible to infrequent high severity crown fires, which will kill all trees within the fire area. Post-fire regeneration occurs via wind-dispersed seeds from surviving or adjacent trees.

Quaking aspen (*Populus tremuloides*): In general, aspen is thin barked with little heat resistance. Small-diameter aspen is usually top killed by low-severity surface fires. While large aspen may survive low-severity fire, they usually show damage. Moderate-severity fire usually top kills most aspen although some of the largest trees may survive. Moderate-to-high severity fire does not damage aspen roots, but high-severity fire may kill roots near the surface while leaving the deeper roots undamaged. Following a fire, aspen sprouts or suckers from the roots and also establishes from off-site, wind-blown seed.

In addition to the five fire regimes outlined in the National Fire Plan, three condition classes have been developed to categorize the current condition with respect to each of the historic fire regime groups. Current condition is defined in terms of departure from the historic fire regime determined by the number of missed fire return intervals (with respect to historic fire return interval) and the current structure and composition of the system resulting from alterations to the disturbance regime. Note that the relative risk of fire-caused losses of key ecosystem components increases for each respectively higher numbered condition class, with little or no risk at Condition Class 1.

Table 3-33. Condition class¹⁰ descriptions.

Condition Class	Fire Regime
1	Fire regimes are within a historic range and the risk of losing key ecosystem components is low. Vegetation attributes (species composition and structure) are intact and functioning within a historic range.
2	Fire regimes have been moderately altered from their historical range. The risk of losing key ecosystem components is moderate. Fire frequencies have departed from historical frequencies by one or more return intervals (either increased or decreased). This results in moderate changes to one or more of the following: fire size, intensity and severity, and landscape patterns. Vegetation attributes have been moderately altered from their historical range.
3	Fire regimes have been significantly altered from their historical range. The risk of losing key ecosystem components is high. Fire frequencies have departed from historical frequencies by multiple return intervals. This results in dramatic changes to one or more of the following: fire size, intensity, severity, and landscape patterns. Vegetation attributes have been significantly altered from their historical range.

The following table summarizes the condition classes for the fire regimes currently identified on the Bighorn National Forest. These figures were derived through the use of GIS, using species and structural stage as the determining variables. As the table indicates, the majority of the acres in Fire Regimes 4 and 5 (long fire return interval) are in Condition Class 2. This implies they have missed at least one fire return interval. Due to the long fire return interval of the species involved, these stands likely are at the upper end of Condition Class 1 or early into Condition Class 2, so it was somewhat of a judgment call to place them into Condition Class 2. It should be noted that approximately 10% of the total area on the Bighorn National Forest is naturally not vegetated (rock, bare soil, and water).

Table 3-34. Fire regime and condition class.

Fire Regime	Condition Class	Cover/Vegetation Type	% of Vegetated Acres on Forest
1	1	Ponderosa pine	<1%
1	2	Ponderosa pine	<1%
1	3	Ponderosa pine	3%

¹⁰ Current conditions are a function of the degree of departure from historical fire regimes resulting in alterations of key ecosystem components such as species composition, structural stage, stand age, and canopy closure. One or more of the following activities may have caused this departure: fire suppression, timber harvesting, grazing, introduction and establishment of exotic plant species, insects or disease (introduced or native), or other past management activities. Source: *Protecting People and Sustaining Resources in Fire-adapted Ecosystems: A Cohesive Strategy*.

Fire Regime	Condition Class	Cover/Vegetation Type	% of Vegetated Acres on Forest
2	1	Sagebrush/Grass/Forb	<1%
2	2	Sagebrush/Grass/Forb	<1%
2	3	Sagebrush/Grass/Forb	29%
3	1	Limber pine/Douglas-fir/Rocky Mtn. juniper	<1%
3	2	Limber pine/Douglas-fir/Rocky Mtn. juniper	8%
3	3	Limber pine/Douglas-fir/Rocky Mtn. juniper	4%
4	1	Lodgepole pine	2%
4	2	Lodgepole pine	27%
4	3	Lodgepole pine	3%
5	1	Engelman spruce/Subalpine fir/ Aspen	1%
5	2	Engelman spruce/Subalpine fir/Aspen	21%

Source: Protecting People and Sustaining Resources in Fire-Adapted Ecosystems: A Cohesive Strategy.

Fire Hazard Analysis

The potential for wildland fire is measured in terms of fire hazard and resistance to control. Wildland fire hazard can be directly related to stand age, stand structure, live and dead fuel loads, and their resulting effects on fire behavior. In an effort to model fire behavior, fire managers have developed fire behavior modeling systems. Two of the most commonly used are the NFDRS (National Fire Danger Rating System) and the FBPS (Fire Behavior Prediction System) models.

NFDRS is used as an indicator of fire potential and fire behavior across broad areas. These areas may include many thousands of acres. FBPS is useful for more site-specific applications. The FBPS model illustrates the differences in fuels and how they react to factors such as wind, humidity, and topography after an ignition occurs.

Output from the FBPS can be rated based on relative resistance to fire suppression activities. The classifications usually used are low, moderate, high, and extreme which are a function of flame length and rate of spread. Low resistance to control typifies fires that are relatively easy to suppress in short time frames. Although fires in the low hazard category generally correspond to the shortest flame length and lowest intensity levels, they can exhibit rapid rates of spread and other elements of extreme fire behavior when subjected to very low humidity and/or high wind speeds. High-resistance fuels typically consist of the older age conifer fuel types with heavy fuel loading or shrub lands with extreme fuel loading (e.g., older stands of sagebrush). These fuels can often produce extreme flame lengths and fire intensities, which exceed the capability of direct fire suppression action.

In an effort to model fire hazard on the Bighorn National Forest, a forest-wide analysis was completed using GIS (Geographic Information System), FlamMap (Finney 2000), RMRIS (Rocky Mountain Resource Information System), and CVU (Common Vegetative Units). FlamMap is a computer program that produces fire behavior values (e.g., rates of spread, flame lengths) based on weather and physical characteristics of the ground and allows the user to produce fire behavior maps.

The objective of this hazard analysis is to quantify flame length, using 90th percentile weather¹¹, across the landscape. Flame length is a function of fireline intensity. It is used to estimate the difficulty of controlling a fire, as well as to estimate whether the fire will torch (ignite the crown of an individual tree or crowns of groups of trees), spot (embers from the fire land on unburned fuels and ignite new fires), or crown (transition from the surface into the tree tops and continue to advance in the crowns).

Flame lengths are routinely grouped into four categories: (1) low – flame lengths four feet or less, (2) moderate – flame lengths greater than four feet and less than or equal to eight feet, (3) high – flame lengths greater than eight feet and less than or equal to eleven feet, and (4) extreme – flame lengths greater than eleven feet. These groupings are commonly used fire behavior thresholds and are further described in the “Hazard and flame length summary” table.

Methods for Determining Fire Hazard

Fire hazard can be directly related to stand age, stand structure, live and dead fuel loads, and their resulting effects on fire behavior. Differences in fuels and how they react to such factors as wind, humidity, and topography are also considerations.

Crown base height (CBH), crown bulk density (CBD), canopy cover, and stand height were determined for the average site for each cover type and subsequently for each forested fuel model identified on the Bighorn National Forest. Live and dead fuel moisture levels and wind speed and direction were determined using historical Remote Automated Weather Station (RAWS) weather station data processed through Fire Family Plus. Fire Family Plus is a computer software program for summarizing and analyzing historical weather observations and computing fire danger indices. GIS was used to create a fuel model layer and the above information was used for FlamMap, which is a program to display fire hazard.

Fuel models are mathematical descriptions of fuel properties that allow the user to realistically estimate fire behavior. A fuel model layer was created in GIS based on the 13 standard Fire Behavior Prediction System (FBPS) fuel models (Anderson 1982). The following table lists the FBPS fuel models identified for the Forest. It should be noted that approximately 10% of the total area on the Bighorn National Forest is naturally not vegetated (rock, bare soil, and water).

¹¹ 90th percentile weather represents days when the fire danger is very high to extreme—a combination of low humidity, high temperature, and high winds. It should be noted that percentiles can be approximated to seasonal fire behavior nomenclature where 90th percentile equates to “drought conditions.”

Table 3-35. FBPS fuel models.

Fuel Model	Description	% of Vegetated Acres on Forest
1	Short grass	20%
2	Timber with grass understory	4%
5	Brush (short brush/seedlings/sapling)	5%
6	Sagebrush	6%
8	Closed timber litter	48%
9	Hardwood litter	1%
10	Timber (litter and understory)	16%

Because crown base height (CBH), crown bulk density (CBD), stand height, and canopy cover were determined for each timbered fuel model identified on the forest, the model was able to calculate surface to crown fire transition, as well as, crown fire behavior.

Fuel moisture is a critical component for evaluating fire hazard. Fuel moisture is the amount of water in a fuel, expressed as percent of its oven-dry weight. Moisture content influences how quickly a fuel will ignite and how well it will burn. When the moisture content of fuels is high, fires do not readily ignite and will burn poorly if at all. When the moisture content is low, fires start easily and influences such as wind can cause rapid spread with high intensity (National Interagency Fire Center 1994).

Wildland fuels are any organic material, living or dead, that can ignite and burn. Living vegetation, such as grasses, forbs, shrubs, and trees, may actively contribute to a fire's energy or may retard the spread and intensity, depending on the moisture level of those fuels. In live fuels, moisture content changes seasonally, exhibiting the highest moisture content during spring green-up with moisture content decreasing throughout the growing season and culminating in the lowest moisture content as fuels cure or enter dormancy. Dead fuel moisture is a function of weather conditions (specifically, precipitation and relative humidity) and the fuel's reaction to changes in weather is a function of composition (e.g., duff, needles, leaves, sound wood, rotten wood), size (depth of the duff, diameter of the wood), and shape (surface to volume ratio, etc.).

Timelag is defined as the time it takes a dead fuel to reach 63% of the difference between its initial moisture content and equilibrium moisture content¹² due to changes in its environment. Dead fuels are classified into timelag groups according to the time it takes them to gain or lose moisture in response to wetting or drying cycles. Each timelag group includes dead fuels of specific diameter ranges. In general, the smaller the fuel diameter, the shorter the timelag, which is primarily a function of surface to volume ratio. Fine fuels (those with very small diameter) have a high surface to volume ratio, which is conducive to moisture exchange. The

¹² Equilibrium moisture content is the level at which dead fuels neither gain or lose moisture with time, under specific constant temperature and humidity. At equilibrium moisture content, a fuel will have no net exchange of moisture with its environment.

standard dead fuel timelag classes with associated diameter ranges are displayed in the following table.

Table 3-36. Dead fuel timelag classes.

Timelag Class	Fuel Diameter
1-hour	Less than ¼ inch
10-hour	¼ to 1 inches
100-hour	1 to 3 inches
1,000-hour	Greater than 3 inches

The 1-hr fuels (grasses, small twigs, pine needles) gain or lose moisture faster than 10-hr, 100-hr, or 1,000-hr fuels. They dry out faster and reach their equilibrium moisture content more rapidly. When dried to a point below their respective moisture of extinction, they can ignite and burn readily. The moisture of extinction is the fuel moisture content at which a fire will not spread or spreads only sporadically in a non-predictable manner. Conversely, an increase in atmospheric moisture (precipitation, fog, high humidity) can keep them from igniting or burning if their percent fuel moisture is near or above their moisture of extinction. These fuels are the greatest contributor to fire intensity at the flaming front. In contrast, under normal conditions 1,000-hour fuels are considered a heat sink and not a heat source primarily due to their low surface to volume ratio. Although they may not contribute directly to fire intensity at the flaming front,¹³ they increase intensity following passage of the flaming front and as such are important in resistance to control of fires.

Surface wind speed is often the most critical weather element affecting fire behavior and fire danger. It is also the most variable and, consequently, the hardest to evaluate. Winds that persist for one minute and momentary gusts both affect fire behavior. For this analysis, both the probable maximum one-minute wind speed and probable momentary wind gust were used because both play important roles in fire behavior. Probable maximum 1-minute wind speed was used because winds that persist for one minute can affect gross fire behavior, including rate of spread and fireline intensity, thereby affecting surface to crown fire initiation and transition. Probable momentary wind gust was used because gusts can produce large, temporary fluctuations in flame height and can easily trigger crowning or shower embers across the fireline.

Fuel moisture, wind speed, and wind direction values were obtained using historic weather data for the period from 1969 – 2002 from the Burgess, Hunter, Schoolhouse Park, and Mill Creek weather stations and RAWS which are representative of the Forest. A comparison of weather data from these stations indicated a close correlation among the various areas of the Forest. As a result, it was decided to use an average range of values from these stations. The following table summarizes 90th percentile weather from weather stations.

¹³ Flaming front is the zone of a moving fire within which the combustion is primarily flaming. The flaming front in light fuels is typically shallow, whereas, a deeper front occurs with a component of heavier fuels.

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Table 3-37. Range of fuel moisture levels and wind speeds based on historic weather data for the Bighorn National Forest.

1-hr fuel moisture level % by wt.	10-hr fuel moisture level % by wt.	100-hr fuel moisture level % by wt.	20 foot Wind Speed MPH	Probable max. 1-min wind speed MPH	Probable momentary gust MPH
4-5	4-6	7-9	14-17	19-22	28-32

This percent range of fuel moisture levels indicates extreme fire conditions on the Forest. Although the wind speeds by themselves are not problematic, when combined with very low fuel moisture levels, fires are more likely to display extreme behavior—characteristics beyond those exhibited by most fires. Extreme fire behavior generally precludes methods of direct control action and includes one or more of the following characteristics: high rates of spread, prolific crowning and/or spotting, fire whirls, and a strong convection column. Although relatively few fires exhibit extreme behavior, those that do, present many challenges in suppression, and in providing for firefighters and public safety. Predictability is difficult since these fires often exercise some degree of influence on their environment.

Fuel models, crown base height (CBH), crown bulk density (CBD), canopy cover, stand height, fuel moisture levels, and wind speeds were input into FlamMap and used to obtain flame length. As previously mentioned, flame length is used to estimate how difficult it is to control a fire and whether the fire will torch, spot, or crown. The following table displays hazard ratings with associated flame lengths, and implications for fire suppression.

Table 3-38. Hazard and flame length summary.

Hazard Rating	Flame Length (feet)	Fire Suppression Interpretation
Low	Less Than 4	Fires can generally be attacked at the head or flanks by persons using hand tools. Handline should hold the fire.
Moderate	4.1 to 8.0	Fires are too intense for direct attack on the head by persons using hand tools. Hand line cannot be relied on to hold fire. Equipment such as dozers, engines, and retardant aircraft can be effective.
High	8.1 to 11	Fires may present serious control problems, i.e., torching, crowning, and spotting. Control efforts at the head of the fire will probably be ineffective.
Extreme	Greater Than 11	Crowning, spotting, and major fire runs are common. Control efforts at the head of the fire are ineffective.

The following table displays acres in the fire hazard rating class calculated for the probable maximum 1-minute wind speed of 17 and 22 miles per hour (mph), and the probable momentary gust, 32 mph using current stand conditions. The effect of these different wind speeds is particularly noticeable in the extreme hazard classes. Acreage in this class is significant because it indicates resistance to fire suppression efforts. 20-foot winds refer to the

standard height for wind measurements used by land management agencies in the U.S. Wind speeds are measured 20 feet above the surface, adjusted for vegetation depth (Rothermel, 1983). The fire hazard rating class was run for the Bighorn National Forest, as a whole, because there is not a distinct difference between the various geographic areas of the Forest in regard to fire hazard, with the exception of the Cloud Peak Wilderness. In the Cloud Peak Wilderness, the majority of the land area is rock, bare soil, or water, none of which will carry fire. The fuel moisture and wind elements were obtained using RAWS (Remote Automated Weather Station) and older manual weather data, downloaded to Fire Family Plus and filtered to obtain 90th percentile conditions.

Table 3-39. Percent of area (excluding non-vegetated areas) in each fire hazard rating class for 17 mph winds, 22 mph winds and 32 mph wind gusts for the Bighorn National Forest.

17 mph, 20-foot winds			
Low	Moderate	High	Extreme
58%	26%	7%	9%
22 mph, 20-foot winds			
Low	Moderate	High	Extreme
53%	29%	8%	10%
32 mph, 20-foot winds			
Low	Moderate	High	Extreme
49%	6%	24%	21%

As evidenced by the preceding table, wind has a great influence on increasing fire behavior. To demonstrate the relationship between fuel model and fire hazard rating, the FlamMap flame length (hazard rating) and fuel model layers were intersected using GIS. Based on the results of this analysis (intersection), it was found that at each of the above wind speeds over 80% of the high fire hazard acres and over 50% of the extreme fire hazard acres were in non-timbered fuel models (fuel models 1, 5, and 6).

The hazard rating analysis has some limitations. Since CBD, CBH, canopy cover, and tree height were calculated on the “average” site for each cover type and subsequent fuel model, the analysis underestimates fire behavior at the upper end for each fuel model, especially as it relates to surface to crown fire initiation, transition, and canopy fire behavior. Note that for this analysis, we used worst-case weather and fuel moisture conditions, rather than average conditions.

Fire Risk Analysis

To further evaluate the relationship of fire to overall forest management and protection, fire hazard must be related to risk. Risk relates to the source and number of ignitions, which can

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result from either human-caused or natural (i.e. lightning) ignitions. Although fire risk is simple to calculate, it is often difficult to predict, especially with human-caused fire starts.

Fire risk is the simple measure of fire starts on a 1,000-acre basis per ten-year period (per decade). The fire risk value corresponds to a likelihood of fire starts per 1,000 acres per decade. The following are risk ratings with the ranges of values used to categorize risk.

- ◆ Low Risk: 0 to 0.49 – This projects one fire every 20 or more years per thousand acres.
- ◆ Moderate Risk: 0.5 to 0.99 – This projects one fire every 11 to 20 years per thousand acres.
- ◆ High Risk: ≥ 1.0 – This level projects at least one fire every 0 to 10 years per thousand acres.

The risk analysis used historical fire data from 1970 through 2004. Fire locations were plotted and overlaid on a Forest map. This revealed no definitive, homogeneous geographic areas in which to group fire occurrence; therefore, fire risk was analyzed on the Fire Management Zones (FMZs) established in NFMAS for the Bighorn NF. The Fire Management Zones and associated fire risk are displayed in the following table.

Table 3-40. Fire risk analysis (1970 – 2004) for the Bighorn National Forest.

Analysis Area	% of Bighorn NF	Number of Ignitions	Natural (Lightning) Ignitions	Human-caused Ignitions	Fire Risk
FMZ 1, Bighorn Mountain Face Below 7000 Feet	27%	250	175	75	0.24 Low
FMZ 2, Montane Above 7000 Feet	56%	415	146	269	0.19 Low
FMZ 3, Cloud Peak Wilderness	17%	12	4	8	0.02 Low
Bighorn NF Average		677	325	352	0.17 Low

Source: Fire Management Zones (FMZs), acres, and ignition data are from Bighorn National Forest NFMAS and fire reports.

Over the past five years (2000-2004) the trend has been toward fewer human caused ignitions (75% lightning, 25% human) based on official fire reports.

ENVIRONMENTAL CONSEQUENCES

General Effects

The structure and condition of the vegetative ecosystems on the Bighorn National Forest are dynamic. Climate, natural processes (such as insect and disease activity, fire, and wind events), and human activity all play a role in vegetative condition, structure, live and dead fuel loading, and subsequent fire behavior.

In **Fire Regime 1** which is primarily ponderosa pine, absence of frequent fire and/or management activities trend toward allowing surface fuel loading in the form of dead and down fuels, seedling/sapling trees, shrub vegetation, and overall stand density to increase. This increase in understory fuel load would produce higher surface fire intensity and create conditions in which transition from surface fire to crown fire could occur more readily and more frequently. The stand density would facilitate extreme fire behavior with stand replacement conditions which are uncharacteristic for ponderosa pine. Where this type of fire behavior occurs over large areas, sites are usually slow to regenerate, primarily because tree species associated with this fire regime group are adapted to surface fire, not stand-replacing fire.

Fire Regime 2 includes the drier shrubland communities, specifically sagebrush/grass. These vegetation communities are important food sources for many wildlife species (e.g. sage grouse) and for domestic livestock. Following a fire, this vegetation type usually responds by producing a heavy grass and forb component. Where sprouting vegetation (e.g., bitterbrush and serviceberry) is present, young shoots usually revegetate the site. Absence of fire in these communities is usually indicated by the presence of older, decadent vegetation with reduced forage production (>40% sagebrush canopy cover). Fire behavior in the younger communities with a high grass component typically exhibits rapid rates of spread with relatively short flame lengths. In the older decadent stands that have experienced an absence of fire, flame lengths and fire line intensity are much higher.

Burns within sagebrush communities on the Bighorn National Forest typically are not continuous and often create a mosaic pattern. Re-colonization of the burned area is through seed dissemination and is dependent on the number and location of residual plants, climatic conditions, and/or the size of the burned area.

Fire Regime 3 includes species with fire return intervals ranging from 35 to over 100 years. Specifically, on the Bighorn National Forest, Fire Regime 3 includes species such as limber pine, Douglas-fir, and Rocky Mountain juniper. Fires in these stands will burn with a mixed severity varying from a low intensity understory burn to a high intensity stand replacement burn. Fuels buildup through exclusion of fire and/or management activities is a primary factor in increasing severity of burns in this group. The absence of management activities and/or frequent fire occurrence would trend toward allowing dead and down fuels and understory vegetation to build up to the point of creating a higher intensity fire situation than historically would be expected to occur.

Fire Regime 4 includes older dense stands of lodgepole pine. Lodgepole pine is typically an early-seral tree species that establishes as a result of fire. Lodgepole pine can be the persistent seral stage vegetation on sites with relatively frequent disturbances or the climax vegetation on sites with less regular disturbances. Subsequently, fire return intervals could be as low as 35 years, but are more frequently well over 100 years. On the Bighorn National Forest, fires in lodgepole pine have historically been both surface and stand replacement crown or canopy fires. Dense stands containing accumulated downfall and ladder fuels have high potential to support a stand-replacement fire. Conversely, after a burn that removes most large fuels, young pole-size stands of pure lodgepole pine have a low potential to initiate crown fire due to lack of ground fuels. When a lodgepole pine stand becomes mature or over-mature, tree growth and vigor declines markedly and the likelihood of a mountain pine beetle epidemic increases. Insect epidemics kill many trees that begin falling after a few years, and within 10 to 15 years large amounts of dead woody fuels accumulate which greatly adds to the potential of stand-replacement fire (Langowski 2002).

Fire Regime 5 on the Bighorn National Forest is the long-interval (infrequent) fire return, stand replacement fire regime, which is composed primarily of Engelmann spruce and subalpine fir, with some aspen. Mean fire return intervals in spruce-fir forests range from 100 to well over 150 years. In the event of an extended absence of fire, these species tend to maintain themselves in stable communities until changed by an external force, such as fire, wind, insects, and/or disease activity. After fire, spruce and fir are replaced by lodgepole pine, aspen, or grassy parks, which slowly trend towards climax spruce-fir if left undisturbed.

Appropriate Management Response

Fire has historically and will continue to play, a role in the structure, occurrence, and condition of vegetative communities of the forest. Under the 1985 Forest Plan, the only management response to an unplanned ignition is a suppression strategy. One of the objectives of this revision is to establish a range of acceptable Appropriate Management Response (AMR) actions. Appropriate Management Response is the response to a wildland fire based on an evaluation of risks to firefighter and public safety, the circumstances under which the fire occurs, including weather and fuel conditions, natural and cultural resource management objectives, protection priorities, and the values to be protected (Zimmerman 2001). A wildland fire will either be managed for resource benefits or it will be suppressed. The three AMR strategies allowed for the Bighorn National Forest are defined below:

Direct Control is to immediately and completely extinguish a wildfire. It is associated with high value areas, such as housing and other urban development, campgrounds, administrative sites, ski areas, and areas with high natural resource values. Immediate suppression action needs to be taken in these locations throughout the fire season. Usually this control is restricted to new fire starts, steady-state fires that have not reached large sizes and specific portions of large fires. Fuels treatment for hazard reduction and pre-suppression planning is a high priority where this strategy is utilized.

Perimeter Control is a strategy that seeks to confine the active zone responsible for fire spread. Perimeter control considers firefighter and public safety, site-specific values at risk, and

response costs. Firelines, whether natural or constructed, are used to confine the active zone of spreading fire. Direct or indirect fireline locations are selected to minimize the cost of suppression while recognizing the values that could be lost to the fire. The potential fire effects (beneficial or negative) will be evaluated and recognized when determining fireline location. The time of season and forecasted weather are important considerations affecting fireline location.

Although there are many fuel management opportunities in perimeter control areas, the fire regime dictates the effectiveness and suitability of fuels treatments. Strategies for ecosystem restoration and maintenance may blend well with strategies for hazardous fuel reduction. Near private property, fuels projects are likely to be directed at defensible space to protect structures while in the more remote areas, ecological values would be emphasized.

Prescription control emphasizes the natural role of fire in the environment. Human-caused fires cannot be managed for resource benefit under current policy. Under prescription control, a fire is considered controlled as long as it burns within specified geographic boundaries and is meeting the intended resource management objectives. Implementation guidance for this strategy is documented in the Fire Management Plan. The Wildland Fire Implementation Plan (WFIP) is the tool that examines the available response strategies when a fire is being considered for wildland fire use. Fires that meet implementation guidance criteria and are meeting the intended resource management goals are allowed to burn. If a fire designated for wildland fire use (prescription) is no longer achieving the intended resource management objectives and contingency or mitigation actions have failed, the fire will be declared a wildfire. Once a wildfire, it cannot be returned to wildland fire use status (USDA Forest Service 2005). Should a fire jeopardize investments or other critical resource values, a suppression response will be implemented. Prescribed fire is an appropriate management tool in most prescription control areas. Some of the factors to be considered in developing operational guidance for implementation of the fire management strategies which will be detailed in the Forest Fire Management Plan are:

- ◆ Season (time of year)
- ◆ Energy release component
- ◆ Wind potential
- ◆ Availability of suppression resources
- ◆ National and Regional planning levels
- ◆ Topography, fuels, and expected fire behavior
- ◆ Consistency with area's desired future condition and the fire's potential to enhance or detract from it.

For each wildland fire use action, the Agency Administrator (or delegated individual) is required to initially affirm and periodically reaffirm the capability to manage the fire as a WFU event. This process is intended to document and ensure management accountability throughout the duration of the wildland fire use.

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An AMR is assigned to every area on the Forest with burnable vegetation. These options range from monitoring with minimal on-the-ground actions to intense suppression actions on all or portions of the fire perimeter depending on the strategy assigned. The map in Revised Plan Appendix D shows the AMR's assigned for the various areas of the Forest. A more detailed map is on file at the Bighorn National Forest, Supervisor's Office. Operational guidance for the implementation of the AMR (direct, perimeter or prescription control) will be documented in the Forest Fire Management Plan (FMP). The Revised Plan is the decision document and the Fire Management Plan contains the guidance to implement the Revised Plan.

When developing the implementation guidance, it may be necessary to refine the AMR boundaries to adequately address the needs of those areas with special attention to high value areas (resource and/or improvements) and areas identified as priorities within Community Wildfire Protection Plans. For example it could be necessary to move from a prescription (wildland fire use) response to a more restrictive suppression response (perimeter or direct) because of the on-the-ground conditions such as the small size of the area and/or the presence of values at risk.

A Fire Management Unit (FMU) is a land management area definable by objectives, management constraints, topographic features, access, values to be protected, political boundaries, fuel types, major fire regime groups, etc. that set it apart from the characteristics of an adjacent FMU. The FMUs established within the Bighorn National Forest FMP were developed with consideration of these attributes. AMR was not an element of consideration in development of the Bighorn FMUs (a single FMU may encompass areas with differing AMRs).

The appropriate management response implemented for a wildfire is developed in response to an analysis of the current situation (fire location, weather resource availability and other site specific conditions), values to be protected, forest plan management objectives, external concerns, and other land uses. Depending on conditions and values at risk in a particular area or time, managers may select a method more intensive than that specified for the area but not one that is less intensive. For example, if an area has been assigned a primary strategy of prescription control, direct control may be used if warranted by the conditions at the time.

Table 3-41. Appropriate management response (acres/percent) by alternative.

Alternative	Direct		Perimeter		Prescription	
	Acres	Percent	Acres	Percent	Acres	Percent
A	1,358	0.1%	598,678	54.2%	504,977	45.7%
B	2,580	0.2%	273,251	24.7%	829,180	75.1%
C	2,580	0.2%	133,366	12.1%	969,068	87.7%
D-DEIS	8,153	0.7%	618,966	56%	477,892	43.3%
D-FEIS	23,151	2%	651,407	59%	430,454	39%
E	2,540	0.2%	802,288	72.6%	300,186	27.2%

Acres of Fuels Treatment (mechanical and prescribed burning) by Alternative

An estimate was made of the number of acres of fuels treatment attainable annually under each alternative. This was based on values at risk, historic funding level experienced by the Forest, objectives of the 1985 Forest Plan, and management objectives for each alternative. The highest priority for mechanical treatments will be adjacent to high-value areas, communities at risk, and areas identified in Community Wildfire Protection Plans. Because fires in long return interval fire regimes are typically high-intensity, stand-replacing fires, fuel treatments adjacent to high-values in those areas would likely concentrate on defensible space. Among the high value areas on the Bighorn National Forest are lodges, resorts, primary residences, summer homes/summer home groups, campgrounds, administrative sites, ski areas, and areas of high resource values. All fuel breaks created will require maintenance. The type and interval of the maintenance will be determined through project-level planning. The highest priority for use of prescribed fire will be in Fire Regimes 1, 2, and 3 with condition classes of 2 or 3 and for maintenance of condition class. Where prescribed fire can safely be implemented to reduce fuel hazard adjacent to high value areas, those areas will receive preference.

The table below displays the percentage of acres of Condition Classes 2 and 3 and acres of high and extreme hazard classes (see Existing Condition section) being treated over a ten-year planning period, for each alternative. It is important to note that, while prescribed burning results in benefits to the fuels profile and/or condition class, often a goal of the burn will be to improve wildlife habitat or range condition for domestic livestock.

Table 3-42. Acres of fuel treatment annually by alternative.

	Alternative					
	A	B	C	D-DEIS	D-FEIS	E
Annual Acres of Treatment	2,610	4,520	1,860	3,970	4,100	3,370
Potential Maximum Percent of Condition Class 2 & 3 Treated per Decade*	2%	4%	2%	4%	4%	3%
Potential Maximum Percent of High and Extreme Hazard Ratings Treated per Decade Based on 22 mph FlamMap Outputs*	15%	26%	11%	22%	23%	19%
Potential Maximum Percent of High and Extreme Hazard Ratings Treated per Decade Based on 32 mph FlamMap Outputs*	6%	10%	4%	9%	9%	8%

* Represents treatments in non-timbered (grass and grass/shrub) and timbered fuel types.

Acres identified for treatment under Alternative A display an average level of treatment under the 1985 Bighorn Land and Resource Management Plan. Alternative B shows a 1,910-acre increase over the historic average. This is primarily due to the increased emphasis placed on fuel treatments by the National Fire Plan, both in urban interface zones and across the landscape and prescribed fire to improve wildlife habitat. Alternative D-FEIS shows a 1,490-acre increase over historic average due to increased emphasis on prescribed fire for vegetative management. Alternative D-DEIS shows a 1,360-acre increase over historic average. Alternative E shows a 760-acre increase from historic average which reflects a higher emphasis of this alternative on timber harvest as a means of treating forested vegetation. Acres proposed for fuels treatment under Alternative C are reduced significantly from the other alternatives. This is primarily due to the increase in special designations (i.e., proposed wilderness) and the emphasis on natural processes.

The actual level of fuels treatment, in any given year, is dependent on funding levels and by weather conditions conducive to implementation of prescribed fire.

Acres Burned by Wildfire

It is very difficult to predict the number of acres that will be burned by wildfire in future years. Conditions that dictate the severity of fire seasons tend to vary significantly year to year. Weather, which is the primary influence on availability of fuels for ignition, is very difficult to predict with any degree of reliability more than a few days into the future. Research suggests that large stand-replacing fires are more likely to occur because of weather conditions than fuel accumulations. Most large fires occur in years with elevated weather variable values and fires in those years account for >99% of the area burned (Bessie and Johnson 1995). Prediction of

major influences, such as the occurrence of drought, is improving, but is still not very reliable. For these reasons, the best method for predicting the number of acres that will burn in the future is to base the prediction on historical fire occurrence.

In an effort to predict the number of acres that will be burned in the future, in a decade, the fire probability analysis program PROBACRE (Wiitala 1999) was utilized. This program assesses the risk of catastrophic consequences from a single wildfire or series of wildfire events. PROBACRE calculates the probability of a major single event, or multiple fire events, and the long-term probability that a combination of fire events, both large and small, would result in a total burned area in excess of a particular number (user-specified). The probabilities are calculated from historic fire information for annual frequency of fires by size class.

The PROBACRE analysis period was 10 years. The probability analysis was completed for the Big Horn Mountain face, Big Horn montane area above 7,000 Feet, Cloud Peak Wilderness, and for the Bighorn National Forest, as a whole. Output from PROBACRE is summarized in the following four tables with additional PROBACRE information available in FEIS Appendix B.

As indicated in the following table, within the Big Horn Mountain face, there is a 92% probability that wildfires will cumulatively burn more than 1,000 acres over the planning period. There is a 55% probability wildfires will cumulatively burn more than 2,500 acres during the planning period. There is a 27% probability wildfires will cumulatively burn more than 5,000 acres during the planning period. There is a 26% probability wildfires will cumulatively burn more than 10,000 acres during the planning period. The probability of wildfires cumulatively burning over 15,000 acres during the planning period is slight.

Table 3-43. Probability analysis for the Big Horn Mountains face.

Probability of exceeding the	10	acre threshold in	10	years is	1.00000
Probability of exceeding the	100	acre threshold in	10	years is	1.00000
Probability of exceeding the	500	acre threshold in	10	years is	0.99357
Probability of exceeding the	1,000	acre threshold in	10	years is	0.92172
Probability of exceeding the	2,500	acre threshold in	10	years is	0.55173
Probability of exceeding the	5,000	acre threshold in	10	years is	0.27548
Probability of exceeding the	10,000	acre threshold in	10	years is	0.25782
Probability of exceeding the	15,000	acre threshold in	10	years is	0.04046
Probability of exceeding the	25,000	acre threshold in	10	years is	0.00256

As indicated in the following table, within the montane area, there is a 95% probability that wildfires will cumulatively burn more than 1,000 acres during the planning period. There is a 71% probability wildfires will cumulatively burn more than 2,500 acres during the planning period. The probability that wildfires will cumulatively burn more than 5,000 acres is 19% and the probability that wildfires will cumulatively burn more than 10,000 acres during the planning period is very slight.

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Table 3-44. Probability analysis for the montane area above 7,000 feet elevation.

Probability of exceeding the	10	acre threshold in	10	years is	1.00000
Probability of exceeding the	100	acre threshold in	10	years is	1.00000
Probability of exceeding the	500	acre threshold in	10	years is	0.98105
Probability of exceeding the	1,000	acre threshold in	10	years is	0.95091
Probability of exceeding the	2,500	acre threshold in	10	years is	0.70597
Probability of exceeding the	5,000	acre threshold in	10	years is	0.18506
Probability of exceeding the	10,000	acre threshold in	10	years is	0.00056
Probability of exceeding the	15,000	acre threshold in	10	years is	0.00000

In the Cloud Peak Wilderness Area there is a 43% probability that wildfires will cumulatively burn over 10 acres during the planning period.

Table 3-45. Probability analysis for the Cloud Peak Wilderness.

Probability of exceeding the	10	acre threshold in	10	years is	0.43319
Probability of exceeding the	100	acre threshold in	10	years is	0.00000
Probability of exceeding the	500	acre threshold in	10	years is	0.00000

The probability analysis for the total Bighorn National Forest indicates a 98% probability wildfires will cumulatively burn more than 2,500 acres during the planning period. The probability wildfires will cumulatively burn more than 5,000 acres during the planning period is 74%. The probability wildfires will cumulatively burn more than 10,000 acres during the planning period is 28%. The probability wildfires will cumulatively burn more than 15,000 acres during the planning period is 18%. The probability of wildfires burning more than 25,000 acres during the planning period is slight.

Table 3-46. Probability analysis for all of Bighorn National Forest.

Probability of exceeding the	10	acre threshold in	10	years is	1.00000
Probability of exceeding the	100	acre threshold in	10	years is	1.00000
Probability of exceeding the	500	acre threshold in	10	years is	1.00000
Probability of exceeding the	1,000	acre threshold in	10	years is	0.99967
Probability of exceeding the	2,500	acre threshold in	10	years is	0.97561
Probability of exceeding the	5,000	acre threshold in	10	years is	0.73540
Probability of exceeding the	10,000	acre threshold in	10	years is	0.28360
Probability of exceeding the	15,000	acre threshold in	10	years is	0.17874
Probability of exceeding the	25,000	acre threshold in	10	years is	0.02356

Large fires on the Bighorn are frequently the result of wind events which account for considerable fire spread in a relatively short period of time. The growth and spread of large fires on the Bighorn can also be influenced by the presence of non-timbered openings which are common throughout much of the Forest and can serve to slow or halt fire progress depending on specific conditions at the time of the fire. While it is difficult to predict the number of acres that will burn in wildfires in the future, it is reasonable to expect that large fires will continue to occur on the Bighorn National Forest as they have historically when weather and fuel conditions are conducive for large fire growth. Some of these fires may involve significant acreages.

Direct and Indirect Effects

Effects from Timber Management: The fuel profile and subsequently, fire behavior will be affected in sites where timber harvest occurs. Effects to the fuel profile and fire behavior can be both positive and negative.

Surface-fuel loading, crown base height and crown bulk density are the primary stand attributes influencing crown fire initiation and spread. Depending on the silvicultural system being implemented, timber harvest may affect each or all of these attributes. At a minimum, with a silvicultural system that thins the timber stand, crown bulk density is reduced which in turn affects potential for spread of fire through the canopy within the treated stands. After such a timber harvest, a fire may transition into the crowns of individual trees (known as passive crown fire or torching), but movement of fire through the canopy (known as active or independent crown fire) will be inhibited through reduced crown bulk density. A crown bulk density of 0.10 kg m^{-3} appears to be the critical threshold for sustained crown fire spread (Langowski 2002).

When the intensity of a surface fire exceeds a critical level, fire can spread vertically into the canopy. Ground fuels in the form of slash will be temporarily increased as a result of timber harvest, but the manner in which slash is treated after harvest plays a significant role in potential surface fire intensity. Treatment of the slash by various methods, such as, piling, lopping and scattering, and burning can mitigate much of this effect by reducing available fuels and thus, reducing potential intensity of surface fires. Timber harvest can also have the effect of creating a drier microclimate in site specific areas impacted by the harvest. This is a result of increased exposure to solar radiation and increased exposure to weather elements. These areas can represent an increased risk of fires due to the warmer and drier conditions, however, this effect would extend minimally beyond the boundary of the harvest units.

Timber harvest units may affect the spread of fire across the landscape, however, the extent of this effect is dependent on the size of the harvest units, location of units in proximity to fire spread and the intensity of the fire. High intensity, stand replacing fires which are typical within the fuel types prevalent on the Bighorn National Forest would most often involve spotting well ahead of the fire front in which case timber harvest units would have little to no effect in slowing or stopping fire progress. In the case of a smaller, less intense fire, treatment units could serve to slow the fire's advance. Harvest units may also provide anchor points for fireline construction and safety zones for fire suppression resources for a period of time after slash is treated.

Very large landscape type treatments could possibly be effective at slowing or stopping the progress of a wildfire due to a reduced amount of fuel available for a fire to burn. This possible effect would be dependent on the proximity of fire starts and direction of fire spread in relation to the treatment areas. Since it is not possible to predict where fires will start and since none of the alternatives include these large scale landscape treatments, this scenario was not analyzed in detail.

FlamMap runs were conducted for each alternative utilizing stand conditions projected by the Stanley model at 10 and 50 years in the future. A comparison of these FlamMap outputs indicates very little variation for the hazard ratings from one alternative to another. The general trend for all alternatives at lower and moderate wind speeds is for the majority of the vegetated area to be in the low and moderate hazard categories. At the highest wind speed, there is a progression of additional area into the high and extreme categories in all alternatives. The lack of variation in hazard ratings between alternatives suggests that differing timber harvest levels under the alternatives (based on Stanley outputs) will have little effect on the overall fire hazard of the Forest.

Timber harvest operations and associated road construction may present a slightly increased potential for fire occurrence caused by mechanized equipment and other increased activity in the short-term while operations are in progress. Thus, the more timber harvest implemented, the greater the potential for these types of person caused fires. Timber sale contracts include clauses that address fire prevention and suppression, which would mitigate most of this potential. Among the timber sale contract provisions are requirements for mufflers and approved spark arrestors, requirement for fire extinguishers with saws and equipment, restrictions on smoking, blasting, and welding, and requirement that timber sale purchaser take suppression action on any fire occurring on the sale area.

Since timber harvest can have some long term beneficial effects in regard to fuels reduction, alternatives with the highest projected allowable sale quantity (ASQ) would have the most benefit in terms of fuels reduction. These alternatives would also have a slightly higher, short-term, human-caused fire risk due to equipment operation, slash generated, and drier microclimate created by harvesting. Alternative E has the highest projected ASQ, followed by Alternatives A, D-DEIS, D-FEIS, and B. Alternative C has the lowest ASQ, emphasizing natural processes to sustain ecological systems.

Effects from Travel Management and Recreation: Historical fire records dating back to 1970 indicate that approximately 30% of the fires on the Forest have been accessible by roads. Although roads can aid in fighting fires by providing ground access to the fires and access for fuel treatments, they also provide access for recreation use, which increases the potential for human-caused ignitions. Increased human use of the forest may also result in the more timely reporting of fires which could result in fewer acres burned. Roads can serve as anchor points for fireline construction by suppression forces and can serve as barriers to the spread of lower intensity fires. High intensity fires typical of the fuel types predominating much of the Bighorn National Forest would likely exhibit extreme radiant heat and spotting well ahead of the fire front which may make roads relatively ineffective as barriers to high intensity fire spread. For less intense fires, roads can be a very effective barrier to fire spread. When a fire is accessible

by road, response times for initial attack are reduced and road access during extended attack improves logistics (thus reducing costs) of managing fires. Any alternative that would increase the miles of roads on the Forest would realize both the positive effects of better access to manage fires and the negative effect of a higher risk of human-caused fires. Alternatives that decrease road miles would likewise have both positive effects by decreasing human use and thus the chance for human caused ignitions and negative effects by reducing accessibility for firefighting equipment.

A significant change in the miles of road on the Forest could, to some degree, change the make-up of the Forest's firefighting force. For example, because much of the Forest currently has limited road access, engines are often not useable on Bighorn fires, so ground crews and helicopters are relied upon for suppression efforts. If considerable miles of roads were to be added, engines could become more important in fighting fires on the Forest. Conversely, if the miles of roads were to be significantly reduced, the current number of engines on the Forest could possibly be reduced in favor of hand crews and/or air resources (helicopters).

Under all alternatives, the number of miles of existing roads to be decommissioned would be the same, so there is no difference between alternatives in regard to effects resulting from decreased road access. Increases in road miles would be closely related to the timber harvest levels of the alternatives. The effects (both positive and negative) from increased road miles would be the greatest in Alternative E, followed by A, D-DEIS, D-FEIS, B, and C which reflects the anticipated levels of road construction under the alternatives.

Effects from Wilderness and Research Natural Areas: There are two objectives of fire management in wilderness: (1) to permit lightning caused fires to play, as nearly as possible, their natural ecological role within wilderness, and (2) to reduce, to an acceptable level, the risks and consequences of wildfire within wilderness or escaping from wilderness (Forest Service Manual 2324.21).

Implementation of Revised Plan fire management strategy occurs through the Fire Management Plan, Operational Wildland Fire Use Plans, and individual Wildland Fire Implementation Plans. Although Wildland Fire Use may be desirable in wilderness areas and Research Natural Areas, it is possible that it may not be applicable in some of these areas due to the size of the area, proximity to high value areas, or unbroken expanses of fuels leading to areas of high value resources or improvements. These high value areas represent a wide range from private property with a high monetary value to areas that are of high resource value for watershed to areas with high historic values. All areas will be evaluated based on the local situation, values to be protected, management objectives, and external concerns. Small areas are often not feasible for application of wildland fire use due to the potential for the fire to move into areas where wildland fire use is not desired. In general, the larger the area, the more feasible it will be to implement wildland fire use. Therefore, from a wildland fire use standpoint, the alternatives with the most wilderness, proposed wilderness, and research natural areas, especially where they are contiguous to one another, would be the best candidates for implementation of a wildland fire use program. For any fires within designated wilderness or research natural areas requiring suppression, the logistics may be more difficult and cost of suppression may be higher than other areas due to restrictions on use of mechanized equipment and access limitations.

This effect may be off-set by reduced costs associated with wildland fire use instead of expending funds for suppression and by the resource benefits derived from allowing fire on the landscape. Through implementation of WFU, fire would be allowed to play its natural role in the ecosystem which would restore, improve, or maintain the health of the ecosystem. Plant species that regenerate through fire and animal species that require snag habitat would benefit from implementation of WFU and prescribed fires. Areas in which WFU fires actually occur are less likely to experience fuels buildup that would result in uncharacteristically intense fires which could cause losses of key ecosystem components.

Alternatives with the most area in wilderness and RNAs would provide the greatest opportunity for implementing WFU and consequently would yield more of the benefits associated with WFU and prescribed fires. Alternative C proposes the greatest amount of wilderness above the current level (approximately 151,955 additional acres) followed by Alternative D FEIS (approximately 33,857 additional acres). Alternatives A, B, D-DEIS, and E propose no additional wilderness. Alternatives B, C, and D-DEIS propose an additional 21,190 acres in RNAs. Alternative D-FEIS proposes approximately an additional 4,956 acres of RNA. Alternatives A and E recommend no additional RNAs.

Effects from Livestock Grazing and Big Game Use: Since grass and forbs are the primary carriers of surface fire in open forested areas, shrublands, and grasslands, grazing (by domestic livestock and to a lesser degree by wildlife) has the effect of reducing fire intensities through the reduction of available fuels. The degree to which fire intensities may be reduced is dependent on how much of the grass and forb production is removed through grazing. Grazing also can have an effect on the ability to successfully implement prescribed fire, for example, it is sometimes necessary to rest an area from livestock grazing for a season prior to burn implementation in order to have sufficient grass to carry the fire.

Grazing would continue to have the most effect on reducing fire behavior in fire regimes 1 and 2, which includes ponderosa pine, grass communities, and shrublands (primarily sagebrush). Fire regime 3, which includes Douglas fir, Juniper, and Limber pine does not generally produce heavy grass/forb fuel loads due to predominantly dry sites along with often poor soil conditions. Fire regimes 4 and 5 (long-interval fire regimes with Lodgepole pine, Spruce, and Subalpine fire) have a minimal grass/shrub component and notice little effect from grazing. In aspen stands, grazing affects the understory and can limit regeneration.

The level of livestock grazing would be very similar between alternatives, so the effects of grazing on fire and fuels would be nearly identical under all alternatives.

Effects from Insects and Disease: Insect and disease outbreaks in forested communities affect the fuels profile and have a subsequent effect on fire behavior and fire suppression activities. The extent of the effects from dead and dying trees is dependent on the scope of the infestation. Small endemic occurrences of insect infestations or disease may have little or no effect on fire behavior or suppression activities, while epidemic or large scale outbreaks can have significant effects. Both types of outbreaks have naturally occurred on the forest throughout time.

When tree mortality occurs as a result of insects or disease, the needles die, but may persist on the branches for several years. The length of time the needles will persist depends on the tree

species. This creates a situation conducive for transition from surface fire to the canopy and possibly fire spread through the canopy. Among the variables determining whether a fire remains on the surface or transitions to a crown fire are surface fire intensity, vertical fuel arrangement (availability of ladder fuels), and crown flammability (live foliar moisture or fine dead fuel moisture) (NFES 2378). In a healthy stand, during normal climate conditions, foliar moisture content is relatively constant, averaging about 100%. However, when a tree dies, the dead needles respond to climate as a one-hour fuel. It is common for one-hour fuel moistures to drop to 4% and occasionally lower during periods of hot temperatures with low relative humidity. As a result, a dead tree with needles still attached to the branches is much more susceptible to torching than a live green tree. Whether the fire after transitioning into the crowns will become an active crown fire in which the fire moves independently through the crowns is dependent on the crown spacing. Stands in which crowns are closely spaced are more likely to sustain active crown fire than in open stand conditions.

As time passes, the needles gradually fall from the trees, onto the surface and eventually become part of the duff layer. In the short-term, this adds to the surface fuel loading, but since it occurs over a relatively long period of time the effect is gradual and is mollified as the needles become compacted and thus, less available to burn.

Although the smaller fuels as described above are the most important in regard to fire intensity at the flaming front, large fuels are also affected. Dead trees eventually fall to the ground, often as a result of wind. While this greatly increases the fuel loading, it does not increase the fire intensity at the flaming front to a significant degree. The primary importance of this increase in large down fuels is an increase of intensity following the passage of the flaming front, which equates into a longer residence time which influences fire effects. Probably the greatest effect from increased loading of large down fuels is in resistance to control during suppression operations. These heavy, down fuels can generate considerable intensity making direct fire line construction infeasible and they inhibit the line building process. Standing dead trees or snags are a recognized safety hazard in suppression activities due to the possibility of the snags falling on firefighters and for their propensity for showering embers across fire lines increasing the potential for spot fires.

Alternatives emphasizing timber management would have the most potential to limit the spread of insect or disease outbreaks by harvest of diseased or insect infested trees and stands at high risk for disease or insect problems where stands are accessible. These alternatives would also have the most potential to harvest dead and dying trees before they accumulate into a hazardous fuels problem. Alternatives emphasizing timber management would have more potential to salvage dead trees, which would limit fuels build-up due to insect and disease mortality which would reduce resistance to control of fires. Alternative E has the highest ASQ, followed by Alternatives A, D-DEIS, D-FEIS, and B. Alternative C has the lowest ASQ, emphasizing natural processes, such as fire and insect and disease activity. Thus, Alternative A would have the most potential to reduce insect and disease related hazardous fuels buildup, and Alternative C would have the least. However, slash would increase as a result of additional harvest which represents a tradeoff in the short term until slash treatments are implemented to mitigate the activity fuels. Conversely, alternatives with the lowest projected levels of timber harvest would

have the most potential for insect and disease mortality to add to fuel loadings due to less salvage harvesting.

Effects from Noxious and Invasive Species: Increases in fire activity (wildfire and/or prescribed fire) could have the effect of increasing noxious weed spread due to disturbance from the fires directly and from fire suppression operations. Additionally, the stand replacement fires which are most typical on the Bighorn National Forest create conditions conducive to invasion of noxious weeds if seed sources are present. Wildfire severity and occurrence are largely a function of weather (which cannot be accurately predicted more than a few days into the future) and subsequent fuel conditions. Since it is not possible to predict differences in wildfire occurrences or sizes of fires between alternatives, the potential for invasive species spread must be based on other criteria. Alternatives with the most potential for WFU would have more potential for disturbance from fires, but less potential for disturbance from suppression actions. Because fuel treatments can create disturbance which could, in turn lead to the spread of noxious/invasive species with the presence of a seed source, those alternatives with the highest level of fuel treatment would present the greatest potential for noxious weed spread. When all of these factors are taken into consideration, there is little apparent difference between alternatives in respect to their effect on noxious and invasive species.

Cumulative Effects

Past, current, and reasonably foreseeable cumulative effects for fire and fuels were considered and analyzed. The activities listed in cumulative effects table in the Introduction to this chapter were considered in the cumulative effects analysis for fire and fuels. The following cumulative effects were discussed in the context of cumulative effects expected over the next 15-year period. The area of consideration for these cumulative effects is primarily encompassed within the boundary of the Bighorn National Forest with condition class and expected treatments on lands of similar fuel types and directly adjacent to the National Forest boundary taken into consideration. Although fire history was researched back to the early 1900s, fire statistics used in estimating fire risk and acres burned by wildfire included the years 1970 through the present.

Condition Class

Fire suppression activities have had the effect of increasing condition class, particularly in ponderosa pine, sagebrush, and Douglas-fir (Fire Regimes 1-3) vegetation types. The trend for all alternatives will be for current condition classes in Fire Regimes 1-3 (short to moderate fire return interval fire regimes) to experience a net increase, while Fire Regimes 4 and 5 (long fire return interval fire regimes) will not experience a noticeable change during this planning period. As a result, Fire Regimes 1-3 will continue to increase in the potential for uncharacteristically severe fires during this planning period. This is based on the proposed levels of timber harvest and fuels treatment and wildfire occurrence probability analysis. The increase in condition class will be slightly less for those alternatives with higher timber harvest and fuel treatment levels. Thus, the increase would be smallest in Alternative E, followed by Alternatives A, D-DEIS, D-FEIS, B, and C, respectively. Due to the treated acres in comparison to total forest acres, this will be negligible on a Forestwide basis.

In Fire Regime 1, ponderosa pine stands are located at lower elevations on the fringe of the National Forest. Of these fringe areas of the national forest, many are not accessible for timber harvest or fuel treatment due to terrain limitations and ownerships patterns. Much of Fire Regime 1 in the Big Horn Mountains vicinity is on located on lands adjacent to, but not part of, the Bighorn National Forest. These lands are under various ownerships, including private ownership, public lands administered by the Bureau of Land Management, some Wyoming state lands, and some lands to the north within the Crow Indian Reservation. While timber harvest and fuel reduction activities occur to some degree on these lands, the overall level of treatment is such that the trend will be for the condition class in these adjacent lands to increase. The Wyoming Game and Fish Department is anticipating less prescribed fire use on the elk winter ranges than has occurred in the past which will tend to allow the condition class of stands in those areas to increase.

The cumulative effect of more acres of fire regimes 1-3 in higher (increased) condition classes will result in the potential for fires in those fire regimes to exhibit unnaturally high intensity, with increased risk firefighter and public safety and to ecosystem function.

Fire Risk

The risk of ignition from lightning will be the same for all alternatives. The risk of human-caused ignitions could increase as public use of the Forest increases and as development within and adjacent to the Forest increases. Regardless of alternative, development within the wildland urban interface (private lands within and adjacent to the Forest) is anticipated to continue and most likely to increase. The cumulative effects table in the Introduction to this chapter shows that subdivisions adjacent to the forest, such as Hazelton, Onion Gulch, and the area near Dayton are likely to continue to grow and others may develop. The anticipated trend toward continued growth in the wildland urban interface would increase the values at risk from wildfire and potentially increase the incidence of human-caused ignitions. Growth of wildland urban interface also creates greater importance for fire prevention and mitigation activities and increases the complexity and cost of wildland fires that occur in those areas due to safety considerations for firefighters and residents and the values at risk. The fire risk and acres expected to be burned by wildfire are anticipated to be similar under all alternatives.

Air Quality

The smoke created by individual wildfires or prescribed fires on the Forest generally does not have a notable effect on air quality, however, there is a potential for cumulative effects to negatively impact air quality. The emphasis to treat fuels (as shown in cumulative effects table in the Introduction to this chapter) on all land ownerships indicates that fuel treatment (including prescribed fire) will increase in the future. While none of the alternatives in this plan will have any effect on the amount of fuel treatments on adjacent land (non-Forest Service) ownerships, any prescribed fires implemented or wildfires occurring on adjacent lands have the potential to cumulatively affect air quality should multiple ownerships conduct prescribed fires during the same time frames. Anyone who conducts prescribed burning projects within the state of Wyoming must comply with Wyoming Department of Environmental Quality, Air Quality Division, smoke management regulations. Implementation of burning within the

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requirements of these regulations will increase the potential to maintain air quality. Although these smoke management regulations will minimize the chance that air quality will be cumulatively degraded by implementation of burns by multiple burners at the same time, the potential does exist and would be the greatest in those alternatives with the highest projected levels of fuels treatments which are Alternatives B, D-FEIS, D-DEIS, E, A, and C respectively.

Although the alternatives can be ranked for cumulative effects as described above, the differences between the alternatives in regard to overall cumulative effects are relatively slight indicating that potential cumulative effects are very near the same under all alternatives.

Insects and Disease

Introduction

Forest Health

A vegetation management goal of the 1985 Bighorn National Land and Resource Management Plan (1985 Forest Plan) was to "Attain the overall goal of a healthy, vigorous forest." Researchers have been attempting to develop a definition of "forest health" that encompasses the variety of philosophies and viewpoints. In his 1949 "Sand County Almanac," Aldo Leopold stated that "health" is the capacity of the land for self renewal." Expanding on this early thought, one of today's definitions has developed with the evolution of ecosystem management in the National Forests. For the forest plan revision, we are using the following definition: "a desired state of forest health is a condition where biotic and abiotic influences on the Forest (e.g., pests, atmospheric deposition, silvicultural treatments, and harvesting practices) do not threaten resource management objectives now or in the future" (USDA, MP-1513, 1993). This definition recognizes:

- ◆ Land management planning goals.
- ◆ Resource management objectives for all resources.
- ◆ The inevitability of human influences.
- ◆ Insects and disease as part of the forest ecosystem.

Diversity is one of the key elements to maintaining forest health. A forest with a variety of ages, size classes, species mix, and densities has more resistance to catastrophic events than a monoculture of one size, age, species, and density. Forest insects and diseases each have a niche where they prosper. By creating a diverse forest, we can reduce the extent of their niche. Diversity reduces the potential areas where insects and diseases can reach epidemic levels that could produce adverse effects to Forest resource objectives. Diversity in the forest vegetation also acts as natural firebreaks, limiting all but the most severe fires.

Forest Insects and Diseases

Insects and diseases are disturbance processes in the forested ecosystem. They are widespread over the Forest and the effects from their actions can last for long periods. Endemic populations of forest pests are a natural part of an ecosystem. They provide an important role in the nutrient cycle and successional changes of a forest. When populations increase to epidemic levels, the potential for negative resource consequences increases. Losses may include timber volume and value, potential growth of forest vegetation, native plant species and forage condition, quantity and quality of wildlife habitat, recreation opportunities, visual aesthetics, and fuel build up which increases wildfire risk.

In general, a healthy forest contains endemic populations of forest pests. They usually kill isolated, overmature, and stressed trees on an annual basis. A healthy forest is able to keep

insect and disease populations from reaching epidemic levels. The main goal of integrated forest pest management is to keep the forest in a healthy condition.

Generally, stands of lodgepole over 80 to 100 years in age are susceptible to epidemic mountain pine pest outbreaks. Engelmann spruce over 100 to 150 years is susceptible to Engelmann spruce bark beetle outbreaks. When trees are healthy, they can repel beetle attacks by flows of resin that "pitch" the beetles out. Overmature trees and trees growing in dense stands are less resistant to attack. This is particularly true during times of stress, such as drought or after a fire. If beetle populations reach epidemic levels, they successfully attack even the most vigorous trees.

Sound forest management is regarded as a way to develop stands that are more resistant to insect and disease epidemics. Integrated pest management (IPM) strategies involve the collection of available knowledge on pest/host relationships and identifying thresholds for unacceptable damage. Integrated pest management requires consideration of a full range of management strategies and techniques before prescribing treatment designed to reduce damage from any forest pest. Strategies include indirect control (which focuses on increasing forest resistance to epidemics) and direct control (which focuses on reducing the actual insect or disease population). Management strategies can include biological, chemical, mechanical, or manual control and prescribed fire to manage populations.

Those alternatives with the greatest allocation to management areas that allow for a wide range of forest management treatments would be most successful at reducing the impacts of insects and diseases.

It is extremely difficult to determine the probability of insect and disease activity. There can be a large combination of factors or sequence of events (weather or climate, succession in vegetation ages and species, epidemic levels of insects and disease) that affect these disturbances.

Legal and Administrative Framework

National Forest Management Act: Requires assessment of alternative management actions to facilitate balanced, integrated approaches to resource protections and development and implementation of sound management practices to prevent excessive losses due to pests.

Cooperative Forestry Assistance Act of 1978: Sets forth the basic Federal authority for forest insect and disease management and provides for cooperation with states and private individuals.

Code of Federal Regulations 36 CFR 219.16 (a)(2)(iii) allows for the harvesting of stands of timber that have not reached CMAI (Culmination of Mean Annual Increment) "which are in imminent danger from insect or disease attack."

Code of Federal Regulations 26 CFR 219.27 sets the minimum specific management requirements to be met in accomplishing goals and objectives for the National forest System. 36 CFR 219.27(a)(3) requires that all management prescriptions utilize principles of integrated pest management to prevent or reduce serious, long lasting hazards and damage

from pest organisms, consistent with the relative resource values involved. 36 CFR 219.27(c)(2) discusses the ASQ (allowable sale quantity) and states: “Nothing in this paragraph prohibits, salvage or sanitation harvesting of timber stands which are substantially damaged by fire, windthrow, or other catastrophe, or which are in imminent danger of insect or disease attack and where such harvests are consistent with silvicultural and environmental standards.” 36 CFR 219.27(c)(7) states: “Timber harvest and other silvicultural treatments shall be used to prevent potentially damaging populations increases of forest pest organisms. Silvicultural treatments shall not be applied where such treatments would make stands susceptible to pest-caused damage levels inconsistent with management objectives.”

Resource Protection Measures

Numerous forest-wide and management area prescription standards and guidelines exist concerning vegetation. Forest management has been used to increase resilience to insect and disease outbreaks. Sanitation and salvage sales are one forest management tool that may be used to suppress, or to utilize merchantable products affected by insect and disease activity where necessary and allowed.

AFFECTED ENVIRONMENT

Insects and diseases can affect the production of timber resources, wildlife habitat, old growth, recreation opportunities and can increase fire risk. Insects and disease are also a key component of ecosystem processes, creating habitat and serving as prey for many wildlife species.

The most serious insect pest of pine throughout the West is the mountain pine beetle (MPB) (*Dendroctonus ponderosae*). This is a native beetle that can attack and kill all of the pine species (lodgepole, ponderosa, and limber pine) in the Bighorn National Forest. Mountain pine beetle activity in lodgepole pine has historically been relatively light and scattered; however, outbreaks have been recorded in the late 1960s and mid-1970s in the Little Bighorn River area. The ponderosa pine along the eastern slopes of the Bighorn Mountains has gone through a number of outbreaks over the years. In recent years a fluctuating population of mountain pine beetles has killed areas of ponderosa pine along the east face of the Big Horn Mountains. This has occurred mainly in the Sand Turn, Story, Red Grade, and Hospital Hill areas. Many of the infested trees are not on the Forest; however, they are of considerable concern to local residents. Efforts to minimize the mountain pine beetle population have taken place throughout the post settlement history. The Civilian Conservation Corps (CCC) did a number of projects in its day, and records indicate concern over beetle populations date back to the early days of the Bighorn National Forest.

The mountain pine beetle can reach epidemic proportions and kill significant amounts of their hosts. Although beetle behavior is well understood in relation to lodgepole pine stands, the same cannot be said of ponderosa and limber pines. In lodgepole pine, the beetle generally

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attacks large diameter, overstory trees, but once an epidemic starts, smaller trees can also be killed (Amman and Cole 1983). The death of overstory trees influences stand structure and composition, and can lead to stand conversion to other species.

The mountain pine beetle generally completes its life cycle in one year in lodgepole pine, although at higher elevations, it can take two years (McGregor and Cole 1985). Adults typically emerge sometime in July or August and attack standing green trees. On successfully attacked trees, adults lay eggs and larvae develop under the bark. Immature larvae overwinter under the bark, and then finish feeding in the spring and early summer. The developing larvae feed on the phloem, killing the tree.

Mountain pine beetle populations in lodgepole pine are in a large part dependent on the conditions present in the forest. In lodgepole pine, susceptibility to mountain pine beetle is based on three factors (Amman et al. 1977):

- ◆ Average tree diameter.
- ◆ Average tree age.
- ◆ Location by latitude and elevation.

Beetle behavior in ponderosa pine is not as well understood. Forest conditions have been related to beetle susceptibility in the Black Hills of South Dakota and Wyoming. In these areas, beetle susceptibility is based on tree diameter and stand density (Schmid and Mata 1992). Average stand diameters of over 7.0 inches make for susceptible stands. In stands that are above the minimum diameter, stands that have a basal area of over 120 square feet per acre are considered to be high risk. Stands with a basal area between 80 and 120 are moderate risk and those below 80 basal area are low risk (Schmid et al. 1994). It will be assumed that these same criteria are applicable to ponderosa pine on the Bighorn National Forest as well.

Little work has been done on mountain pine beetle behavior in limber pine. What is known is that brood production is fairly high in limber pine, indicating that beetles do very well in this species (Cerezke 1995). It will be assumed that the beetle behaves in much the same way in limber pine as in lodgepole, preferring larger diameter trees.

In both lodgepole and ponderosa pine, the factors that can be managed to reduce a stand's susceptibility to beetles include reducing average diameter and age and/or reducing stand density. Treating the stands to reduce susceptibility would provide the most long-term defense against a mountain pine beetle epidemic. In lodgepole pine, thinning is effective at reducing future losses to the mountain pine beetle (Amman et al. 1988, Cole 1989, Gibson 1989, McGregor et al. 1987). Since beetles are attracted to the largest trees initially, removal of large diameter material is also effective at reducing loss during epidemics (Cahill 1978, Cole et al. 1983, McGregor et al. 1987). Obviously, clearcutting lodgepole pine stands removes any risk of beetle infestation.

Treatments to reduce mortality in ponderosa pine include thinning stands to lower basal area or smaller diameter sizes prior to beetle outbreaks. These types of silvicultural treatments should be effective at reducing loss to the beetle in ponderosa pine. In areas where beetle populations have already become established and started increasing, sanitation harvesting can

be considered. Sanitation efforts prior to the beetle flight period (July - August) may serve to reduce localized beetle spot expansion. However, sanitation harvesting on a small scale does not prevent future bark beetle migration from adjoining areas.

No work has been conducted on silvicultural treatments for reducing beetle damage in limber pine. Based on what is known from lodgepole and ponderosa pine, limber pine stands should be treated to remove the largest diameter trees and reduce stocking levels. Without any real information, these seem to be the safest options for minimizing beetle damage.

Fifty-six percent of the identified limber pine stands are in a condition that would be considered high hazard to a mountain pine beetle outbreak. There are 44% of the limber pine stands that are in a low hazard condition due to tree size or density. There are areas of limber pine that are currently being attacked by mountain pine beetle, with Tensleep Canyon being the most visible. In areas where beetles have already built up, the risk to the surrounding high hazard stands is significant.

Twenty-six percent of the lodgepole pine on the forest is in a state of high hazard to a mountain pine beetle outbreak. The remaining 74% is low hazard. Currently, there are no large outbreaks of mountain pine beetle in lodgepole pine.

Eighty-six percent of the ponderosa pine coertype on the Big Horns is in a state of high hazard for a mountain pine beetle outbreak. Fourteen percent is at low hazard based on average tree size or tree density. Much of the ponderosa pine coertype is on the east face of the mountain, which is currently undergoing a mountain pine beetle outbreak. Any stands in the high hazard are at risk for significant mortality and many of the low risk stands may suffer some mortality considering the current MPB situation.

The most important threat to spruce is the spruce beetle (*Dendroctonus rufipennis*). The spruce beetle is a native bark beetle that occurs throughout the range of spruce in North America. The beetle is typically found at endemic levels in downed trees and large pieces of slash. Epidemic populations most often occur after large disturbances, such as windthrows, create a large volume of suitable host material for the beetle to build up in. Once populations reach an epidemic stage, all sizes of standing green spruce can be attacked except for reproduction. While all sizes can be attacked, it is most often focused on the larger trees within a stand. Epidemics develop as small spruce beetle outbreaks, which increase and coalesce into large areas of infested trees as the beetle continues to attack and kill vast acreages of the coertype (Massey and Wygant 1954, Holsten et al. 1999). Recovery and regeneration of affected stands may be very slow; often spruce is replaced by subalpine fir which, over time, is replaced by spruce again as the fir dies (Schmid and Hinds 1974).

Spruce beetle, unlike mountain pine beetle, is attracted to, and often builds up in, damaged trees. Frequently this is in windthrown/blowdown trees; however, fire-scorched trees also are susceptible. Rasmussen et al. (1996) found an increased number of spruce beetles in trees that were scorched up to a certain level of damage. Once scorching exceeded 60% of the basal circumference girdled, trees were no longer as suitable for spruce beetle infestation. This is something to be considered when using prescribed fire. Many of the larger spruce may have bark thick enough to survive lighter prescribed burns, however, if they are scorched to a

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certain degree, they can be more susceptible to spruce beetle attack. Stands that contain a large number of larger, partially scorched spruce, could be centers for spruce beetle buildup and epidemics.

The spruce beetle usually requires two years to complete a generation; in high elevations it can take three years. Adults fly, attack host trees, and lay their eggs in June and July. Larvae develop under the bark and remain there to overwinter. Larval development continues the following spring and summer, with new adults emerging in August. These adults then hibernate beneath the bark until the following June and July.

Spruce stands that are most susceptible to spruce beetle outbreaks generally have the following characteristics (Schmid and Frye 1976):

- ◆ Located in creek bottoms.
- ◆ Have large diameter host trees.
- ◆ Have high basal areas.
- ◆ Have a large proportion of spruce in the canopy.

Spruce beetle is a concern that should be noted in stands that have large mature and overmature trees. Windthrow events in or near these stands can lead to mortality of standing green trees (Schmid and Hinds 1974).

Forty-eight percent of the spruce/fir covertime rate as a high hazard for a bark beetle outbreak across the forest. Fifty two percent rate in a low hazard condition. These numbers are probably the least accurate of any of the hazard ratings, because so little research has been done on the fir component. Given the lack of published information, the above ratings are estimated to be plus or minus 10-15%. This is evidenced by the current observed spruce/fir mortality throughout the Forest. For spruce beetle, in many cases it is killing all spruce trees down to about 8-10 inches in diameter. Dayton Gulch and Shell Reservoir are two examples of current rising spruce beetle population centers.

The western balsam bark beetle (*Dryocoetes confusus*) infests a number of western conifers but is most significant in subalpine fir. It contributes to subalpine fir decline, which is a poorly understood problem in this species. It is a significant problem on the Bighorn NF; it kills both large diameter and small diameter trees. The decline appears to be associated with the western balsam bark beetle and root disease. The beetle appears to have a 2 year life cycle. Attacking beetles introduce a virulent fungus (*Ceratocystis dryocoetidis* Kend. and Moln), that contributes to the decline of the attacked tree. This insect/root disease association appears to be important in converting fir/spruce stands to predominantly spruce stands over long periods.

As there is no accepted method for risk rating stands for western balsam bark beetle, a conservative estimate for the number of stands at risk would be to use numbers similar to what the spruce beetle show. It is likely that far more fir is at risk, since the beetles will attack and kill much smaller trees than is typically seen with spruce beetle.

The Douglas-fir beetle (*Dendroctonus pseudotsugae*) is a native insect that attacks Douglas-fir throughout its range in North America. It has a single generation per year, generally

overwintering as callow adults. Its life cycle is similar to other bark beetles, with new adults infesting host trees in the summer.

The Douglas-fir beetle is usually found at low densities in the forest. It is often found building to epidemic populations following other disturbance events such as windthrow or fire (Furniss 1962, Furniss et al. 1981). After these disturbance events, beetles can reach levels where surrounding green trees are attacked and killed.

Stands of Douglas-fir can be rated as to their susceptibility to Douglas-fir beetle based on stand density, average stand age and the amount of Douglas-fir in the stand (Weatherby and Thier 1993, Negron 1998, Negron et. al 1999).

Currently, 39% of the Douglas-fir stands are in a condition that leaves them susceptible to large scale Douglas-fir beetle mortality. The other 61% are in a lower hazard state, based on tree size and density. There are a number of areas, Shell Canyon and Tensleep Canyon being the two most obvious, that are also at high risk to Douglas-fir beetle attack considering that there are already high numbers of beetles and beetle killed trees occurring in these areas. Any stands that are in the high hazard category and even many that are borderline between high and low hazard in these areas could be significantly affected.

Western spruce budworm (*Choristoneura occidentalis*) also exists on the Forest. High population levels have been noted in Douglas-fir stands on the northwest side of the Forest, as witnessed by the large area of red topped trees near Mexican Hill. These stands usually are able to survive attacks for a year or two, however, four to five years of continuous defoliation may result in top-killing and tree mortality. This defoliation will make the trees vulnerable to attack by other insects and diseases.

The gypsy moth (*Lymantria dispar*), has been accidentally introduced into areas in and around the Big Horns on a few occasions over the last 20-30 years. As of now, it is not known to have an established breeding population in the Big Horns. The chances of further introductions and the possibility of this insect becoming established in this area are increasing. As more people from infested areas visit and bring campers and recreational vehicles that could harbor gypsy moths into the Big Horns, the chances of this insect being brought in increase.

The gypsy moth is a serious threat to all forest resources. It will feed on the leaves of over 300 trees and shrubs, predominately hardwoods (Liebhold et al. 1995). If established in the Big Horns, the biggest threat would be to riparian and aspen communities.

There are a number of other exotic forest pests that could, in theory, become established in the Big Horns. As with the gypsy moth, any exotic insects that are found should be handled using an eradication plan as soon as possible.

Aspen decline is associated with a variety of canker and stem and root decay pathogens that cause stands to decline, die, and fall apart over time. The usual suspects are stem decays (*Ganoderma applanatum* and *Phellinus tremulae*), root decay (*Armillaria ostoyae*), canker diseases (*Cytospora* sp., *Ceratocystis fimbriata*, and *Hypoxylon mammatum*).

Dwarf mistletoe (*Arceuthobium spp.*) and Comandra blister rust (*Cronartium comandrae*) in lodgepole pine cover the most acres of any disease problems on the Forest. A past Forest survey conservatively estimated 44% of the lodgepole pine had dwarf mistletoe, and 55% was infected with comandra rust. This is an increase in the mistletoe level from similar surveys done in the 1970s on the Big Horns (Harris 2003). The distribution of both diseases is fairly uniform. They extend from the northeast portion of the Forest, along the east side of the Cloud Peak Wilderness, and continuing southwest onto the Tensleep District. Dwarf mistletoe increases mortality and decreases growth and seed production. Young trees can be killed while mature trees may take years to show noticeable damage. The mistletoe infection lowers the resistance of trees to attacks by other diseases and insects.

Dwarf mistletoe spreads at a relatively slow rate through a forest stand. Over long periods of time, especially in the absence of fire, lightly infested dwarf mistletoe stands become severely infested as the pathogen intensifies and spreads. Fire is an important regulator of dwarf mistletoe occurrence, particularly where large-scale stand replacing fires have occurred. These fires eliminate the dwarf mistletoe-infested overstory and understory pines and allow new seedlings to grow free of the plant parasite.

Comandra blister rust (*Cronartium comandrae*) is a native rust fungus that requires two different hosts to complete its life cycle, bastard toadflax and hard pines such as lodgepole and ponderosa pines. The spores are spread by wind from the Comandra plants to infect pine needles and new shoots. The fungus then grows into the branch, creates a canker that kills the branch. These cankers often produce spores that appear as rust-colored blisters; these spores travel from the pine to infect the Comandra plant. As the fungus grows in the tree branch, it will advance towards the tree stem. If the fungus forms a girdling canker on the stem then the top of the tree dies causing top-kill (Mielke 1957).

Timber harvest is one tool for controlling diseases, such as dwarf mistletoe and Comandra blister rust, on the Forest. Areas of high mistletoe risk or infestation are a prime consideration when locating and designing timber sales. Current strategies to control comandra blister rust are generally aimed at reducing the disease rather than preventing infections. One option is to harvest the heavily infected stand while trees are still usable.

White pine blister rust (*Cronartium ribicola*), an exotic disease, infects limber pine trees on the Bighorn National Forest. The rust fungus also infects alternate hosts of currant or gooseberry plants (*Ribes spp.*) to complete its life cycles. The fungal spores are spread by wind from the Ribes plants to infect pine needles. After a short infection time, the fungus will develop cankers that girdle and kill branches and eventually stems. Around the edges of these cankers, the fungus produces blisters of spores that travel by wind to infect the Ribes plants. While spores from Ribes can travel a great distance and still be viable, most pine infections in Wyoming occur in areas where Ribes plants grow in close proximity to the trees (Mielke 1943).

Limber pine is being infested severely in many parts of the forest by white pine blister rust. In places where this disease has moved through in the past, such as Idaho (in western white pine), mortality can be as much as 90-95% of the covertime. It is unknown what the final

impact to limber pine will be on the Big Horn Mountains, however, there are places where the disease has already killed a high percentage of the host trees.

Initial work on root diseases in the Big Horns has started. Armillaria root disease does occur in the Big Horns, and likely Annosus and perhaps others also. Root diseases can be major factors in causing growth loss and even outright mortality in forest stands. Root diseases can be stress factors that increase the likelihood of bark beetle attacks on trees when beetles are at endemic levels. Root diseases can also be major factors in causing tree failures, and so are important organisms in and around developed recreation areas.

ENVIRONMENTAL CONSEQUENCES

Direct and Indirect Effects

Management area prescription designation can greatly influence the occurrence of insect and disease activity and what, if any, actions are taken to minimize impacts.

Natural disturbance events will continue to operate regardless of the alternative, however the scale upon which natural processes operate as the primary agents of change will vary by alternative. Where natural processes are the predominant process, the management of insect and disease populations is less likely. Since insect risk is medium or high on much of the forest, it is possible that many of these acres at risk of insect damage will be attacked within the next 50 years. The same could be said of the disease situation on the Forest. With the current high levels of infection, it is likely there will be continued high levels of tree mortality and stand structural changes over the coming 50 years. The potential exists for large areas of the forest to be subject to large-scale events when high-risk conditions occur.

The emphasis on management activities to prevent or reduce pest populations varies from one alternative to another, and may correspond to levels of timber harvest or other activities that promote greater habitat diversity. Management alternatives that change the mix of age classes, density, and species makeup of forest stands will have the greatest effect on insects and diseases. Those alternatives that put most of their emphasis on natural processes being the major change agent will have greater risk to loss from insect and diseases.

The following table lists the different management area allocations and management area. Management areas are defined in Revised Plan Chapter 2. These management areas can then be grouped into categories, using their first number, these categories (i.e. 1, 2, 3...) have similar levels of forest management activities.

The following two tables show a comparison of land allocation by alternative. Based on the allocation, the amount of insect and disease prevention and suppression possible will change. In the first table, Categories 1, 2, 3, and 4 are listed as where natural processes would predominate, while Categories 5 and 8 are where active forest management is more likely to take place. In the second table, it is assumed that suppression strategies would be rarely used in Categories 1, 2, and 3. Suppression strategies would be occasionally used in lands

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allocated to Categories 4 and 8, and would more frequently be used in Category 5. The amount of active management available for each category will play a major role in how much of the landscape will be affected by insects and diseases.

Based on this, Alternative E should be least susceptible to large insect and disease outbreaks, followed by Alternatives A, D-DEIS, D-FEIS, B, and C in succession. The converse of this is that Alternative C would be most likely to experience large insect and disease outbreaks. These rankings would be the same for which alternatives would use the most aggressive prevention and suppression techniques.

Table 3-47. Allocation to management areas where natural processes or forest management would predominate in acres and percent of forest area, by alternative.

	Alt A	Alt B	Alt C	Alt D-DEIS	Alt D-FEIS	Alt E
Natural process predominate, Category 1, 2, 3, 4, MW	504,979 ac 46%	829,182 ac 75%	969,071 ac 88%	619,959 ac 56%	619,959 ac 56%	300,184 ac 27%
More active Vegetation Mgmt Activities, Category 5 & 8	600,038 ac 54%	275,832 ac 25%	135,946 ac 12%	485,058 ac 44%	485,058 ac 44%	804,828 ac 73%

Table 3-48. Response to insects and diseases, by alternative.

	Alt A	Alt B	Alt C	Alt D-DEIS	Alt D-FEIS	Alt E
Insect and Disease Suppression and/or Control						
Rarely Used, Category 1, 2, 3 & MW	485,831 ac 44%	686,629 ac 62%	800,989 ac 72%	507,467 ac 46%	507,095 ac 46%	289,384 ac 26%
Occasionally Used, Category 4 & MW	20,505 ac 2%	145,133 ac 13%	170,662 ac 15%	113,481 ac 10%	113,853 ac 10%	13,340 ac 1%
Routinely Used, Category 5	598,680 ac 54%	273,252 ac 25%	133,366 ac 12%	484,069 ac 44%	484,069 ac 44%	802,288 ac 73%

Effects from Fire and Fuels Management: The effects of large, destructive wildfires on forest pests would likely be to reduce those that exist in areas where extremely hot fires burn over. Fires can also reduce stand density and make stands more resistant to attack. However, lower burning intensities associated with parts of most wildfires and most prescribed fires can severely weaken the resistance of trees to pest attacks by damaging root systems and cambial tissues. This can in turn lead to increasing populations and subsequent outbreaks of some pest species.

The extent and frequency of large fires often increases following major bark beetle outbreaks, such as currently seen throughout the Rocky Mountains. While there is no history of large scale bark beetle outbreaks on the Big Horns, these unprecedented events are occurring elsewhere in the Rocky Mountains with little history of their occurrence. Large scale insect and disease disturbances can create an increase in dead and down fuels.

Effects from Administrative Site Management: Costs may be higher than for general forest areas to ensure that vegetation surrounding administrative sites is not degraded due to the activity of insects and diseases; however, this will not vary from one alternative to another.

Effects from Timber Management: Timber harvesting and timber stand improvement provides an opportunity to prevent or reduce pest outbreaks. Harvesting trees provides an opportunity to remove diseased and high-risk trees. Clearcuts and other final harvest methods provide opportunities for long-term protection and prevention of insect and disease outbreaks. Stands most susceptible to insect damage and most infected with mistletoe can be harvested and replaced with mistletoe-free young stands. In stands scheduled for overstory removal, shelterwood, or uneven-aged management, individual suppressed or dying trees can be removed, increasing the overall growth and vigor of remaining trees. In commercial and precommercial thinning operations, susceptibility to insects and disease would be decreased by increasing the growth and vigor of the remaining trees.

Alternatives that increase the amount, extent, or density of mature and over mature stands will generally increase the risk of attack by bark beetles. Large scale disturbances caused by bark beetles can change stand structure and effect species changes or changes successional trends. Large disturbances can also have the effect of regenerating expansive areas to basically a single age class, reducing diversity.

Under all alternatives, there exists potential for salvage and/or sanitation cuts to harvest dead or damaged timber and to attempt to slow or impede infestations from spreading. The degree to which these harvests are undertaken would largely depend upon the risks associated with the potential infestation spread into healthy stands, public safety, the presence of high value resources, and the resource emphasis of the infected or adjoining area.

Timber management can help create forests with increased age and species diversity. The more diversity that is present in an area, the less likely large scale epidemics would occur.

Alternatives with the greatest allocation to management areas that allow active forest management would have the least amount of area left at high risk to insect and disease outbreaks.

Effects from Wilderness Management: As land is allocated to proposed wilderness, the amount of suppression and control and silvicultural activities to reduce risk would decrease and the occurrence of insects and diseases would continue without active treatment.

Effects from Riparian Area and Wetland Management: Restrictions on use of pesticides near water may limit some pest management options. As areas are added to National River System, management options available may become constrained causing an increase in pest

activity. Costs of pest management activities may be higher in riparian and wetlands due to more restrictive guidelines. As these restrictions apply to all alternatives, there is no difference between the alternatives.

Effects from Recreation and Travel Management: In developed and dispersed sites, where trees are often impacted by camping activities and overall health and vigor are reduced by soil compaction from recreational uses, insects and diseases can occur at higher levels. Pest management activities would be intensified under all alternatives to protect developed recreation sites. Costs may be higher than for general forest to ensure that vegetation in and around developed recreation areas is not degraded, causing safety hazards due to insects or disease. This should not vary substantially from one alternative to another.

Alternatives B and C that emphasize more wilderness, backcountry, and nonmotorized recreation would have little or no management activity for prevention or reduction of insects and diseases.

Alternatives A, D-DEIS, D-FEIS and E would have more developed road systems that would facilitate the ability to access areas and carry out suppression and silvicultural treatments to reduce pest impacts. A more developed travel system used by recreation activities can contribute to the spread of exotic or nonnative insects or diseases.

Effects from Scenic Resource Management: Generally, the more restrictive the Scenic Integrity Objective, the greater the potential for some pests to be present at potentially damaging levels. Alternatives that limit the amount of forest management practices would lead to denser stands and increased likelihood of bark beetle infestations and continued increases in mistletoe. These alternatives may have an opposite effect on diseases such as root diseases.

Effects from Wildlife Habitat Management and Old Growth: In general, alternatives favoring older age classes of vegetation tend to favor buildup of forest pests. Those that favor a wide range of age classes, greater vertical diversity, and greater species diversity tend to reduce the effects of insects and diseases. Thermal cover for big game is generally very susceptible to insect outbreaks. Alternatives that seek to increase the level of thermal cover would create a higher risk to insect outbreaks.

Trees that are left behind after treatment as replacement snags will generally continue to increase in susceptibility due to size and age. Clumps of trees left after harvest will have the same response only stronger due to being more closely spaced.

Areas that are treated with prescribed fire can have a resulting positive or negative effect from insects and diseases, depending on how the residual live trees are stressed from the burn.

Areas left as old growth will generally be highly susceptible to insect and disease outbreaks. Typically these are stands with larger trees and closed canopies that are highly favored by bark beetles. Maintenance of these stands may call for intensive management.

Effects from Threatened, Endangered, and Sensitive Species Management: The concern for protection of threatened, endangered, and sensitive (TES) plant and animal species will result in specific requirements being met. Concern about these species may result in limited

or no actions taking place. Actions could be delayed beyond the appropriate biological window for treating pests depending on TES species present and their needs.

In general, those alternatives that have reduced levels of management activity and may be more beneficial to mature forest associates also tend to create stand conditions that are more susceptible to insect and disease outbreaks.

Cumulative Effects

The cumulative effects table at the beginning of this chapter includes the list of past, present, and reasonably foreseeable future activities that were considered with regard to cumulative effects to the insect and disease resource. The next 15 years are considered the time span for cumulative effects, and the cumulative effects area of analysis is the forested area on the Big Horn Mountains. Cumulative effects are considered within the Bighorn National Forest, and off the Forest or about three to five miles from the National Forest boundary.

On-Forest Cumulative Effects – Natural Processes

Forest stand density, age, and size have increased and are causing an increased risk of insect and disease outbreaks on a greater number of acres. Over the life of this forest plan, this risk will remain and increase even further as the forest grows and ages. This is a common theme for all forested stands on the Bighorn National Forest.

Silvicultural treatments can offset these effects. Changes to vegetation structural stage from silvicultural treatments can create forests that are more resistant to large scale outbreaks on the forest. Salvage operations would occur in management areas where timber production is emphasized or where needed to reduce hazards in high use recreation areas.

As forest stands age, they pass through different stages of susceptibility to insects and diseases. Generally, mature forest stands are at the highest risk of insect and disease activity where impact may exceed management objectives. As the Forest ages, the susceptibility to insect and disease outbreaks will greatly increase.

Alternatives that implement the greatest amount of hazard reducing activities would have the greatest reduction in insect and disease activity. Hazard reducing activities would be treatments that change stand structure prior to an insect or disease occurrence. Alternative E is least likely to have large, landscape scale insect and disease events across the forest, followed by Alternatives A, D-DEIS, D-FEIS, B, and C. The more acres left to be governed by natural processes, the better the chance of large scale disturbance. With large areas left to natural processes, even treated acres would assume some risk if they are near disturbances. This should be considered in how management areas are located spatially.

Also, Alternative E has the highest number of acres where prevention or suppression tactics could be employed (Table 2). This would make this alternative the least likely to have ongoing, untreated outbreaks of insects or disease, followed by alternatives A, D-DEIS, D-FEIS, B, and C.

One of the biggest considerations would be the public acceptance of leaving much of the forest land in prescriptions that are allowed to follow natural processes. It may present a

dichotomy that is hard for the general public to understand: why some alternatives choose to manage parts of the forest and limit pest populations, while on other large tracts we let nature take its course. The current state of the forested vegetation on the Bighorn National Forest is at a point where natural disturbances will likely make landscape level changes in the near future. The areas where natural processes will predominate will have changes that are as or more significant than those where management takes place. The continued growth and aging of the forest will create conditions that will continue to be highly susceptible to insect and disease disturbance. Those areas where forest management is used on a larger scale would be less susceptible to landscape level changes, however, disturbances that start in areas driven by natural processes could cause change in these areas.

Insect and disease populations in management area designations that emphasize natural processes are difficult, if not impossible to manage within the management area boundary and substantial effects would slop over onto adjacent management areas. This would be most evident in alternative A with smaller management area blocks, and along the management area borders with the most sinuosity.

Off-Forest Cumulative Effects

The same natural process effects would occur on the non-National Forest System forested lands in the Big Horn Mountains. The private, state and BLM forested lands surrounding the National Forest are primarily lower elevation forests dominated by ponderosa pine, Douglas-fir, and limber pine. Therefore, these lands would be most susceptible to mountain pine beetle, Douglas-fir beetle and white pine blister rust. There are some timber harvest activities occurring on these lands, as shown in the table at the beginning of this chapter. However, as on the National Forest, the rate of timber harvest is not expected to stop insect and disease epidemics from occurring over the next decade.

Management of the mountain pine beetle in Story is especially problematic, since some landowners do not want to cut trees on their property. Bighorn National Forest foresters have been called in the past with the issue of one property owner desiring to thin or otherwise treat their property for mountain pine beetle risk, only to have the adjacent property owners refuse to treat their property. It is probable mountain pine beetle would continue to be active in the ponderosa pine forests of the Story area.

Higher elevation subalpine forests occur to the south and north of the National Forest. Private landowners own most of the mountain on the south boundary, and many of them are using timber harvest to lessen the impact of subalpine forest insects and diseases. The Crow Indian Reservation is to the north of the National Forest, and there is little timber harvest activity adjacent to the Forest, as this is a relatively remote area.

The sum of this discussion is that forest landowners adjacent to the Bighorn National Forest have fairly comparable levels of insect and disease activity, and as on the Forest, the levels of treatment are insufficient to keep all insect and disease activity at less than epidemic levels.

Invasive Species

Introduction

This discussion deals with non-native plant and animal species that can adversely affect species composition and ecosystem structure/function. Currently, non-native plants are probably the biggest invasive species threat to the resource values on the Forest, and as a result have received greater management emphasis than that placed on other non-native wildlife and fish species. Non-native wildlife and fish species can also displace native species, alter habitat conditions, and threaten native species population viabilities in the ecosystem where they exist. Although past emphasis has focused on management of invasive plants (e.g., noxious weeds), the Forest will increase monitoring efforts for invasive fish and wildlife species, as well.

Non-native plant management on the Forest is coordinated with county, state, and private vegetation management efforts wherever possible. If non-native animal species become an issue in the future, management would be closely coordinated the Wyoming Game and Fish Department and the U.S. Fish and Wildlife Service.

Legal and Administrative Framework

The following laws and policy and direction from the Forest Service Directives System in Forest Service Manuals (FSM) and Forest Service Handbooks (FSH) pertaining to control and management of noxious and non-native species are listed here but not limited to:

Federal Noxious Weed Act of 1974.

February 3, 1999 Executive Order of Invasive Species.

FSM 2060 Ecosystem Classification, Interpretation, and Application.

FSM 2070 Biological Diversity.

FSM 2080 Noxious Weed Management.

FSH 2090.11 Ecological Classification and Inventory Handbook.

FSM 2150 Pesticide-Use Management and Coordination.

FSH 2109.14 Pesticide-Use Management and Coordination Handbook.

FSH 2509.13 Burned-Area Emergency Rehabilitation Handbook.

Wyoming State and County declared Noxious Weeds.

Bighorn National Forest Noxious Weed EA, 1998.

USDA Forest Service Guide to Noxious Weed Prevention Practices.

Resource Protection Measures

Many invasive plants (such as smooth brome or Kentucky bluegrass), though not necessarily considered noxious, can replace native vegetation. The Federal Noxious Weed Act of 1974 authorizes the Secretary of Agriculture to use an integrated weed management approach to control and contain the spread of noxious weeds on National Forest System and adjacent lands. Through that act, the Forest Service has an obligation to work cooperatively in identifying noxious weed problems and to develop cooperative education and control programs in areas where National Forest System lands are located. Current Forest Service direction for revegetation is to use genetically local (at the ecological subsection level) native species and desirable non-native species where technically and economically feasible. Revised Plan standards and guidelines are intended to direct management to maintain and improve natural vegetative conditions and native plant and animal communities and habitats. The Forest will continue to conduct a noxious weed management program that will minimize the spread of state-listed species, and that implements an integrated program focusing on prevention, early detection, and timely treatment of priority species.

AFFECTED ENVIRONMENT

Noxious Weeds

Noxious weeds are plants so designated by the Secretary of Agriculture or by the responsible state official. They generally possess one or more of the following characteristics: aggressive and difficult to manage, poisonous, toxic, parasitic, a carrier or host of serious insects or disease, and native, new to, or not common to all or part of the United States. In a general sense, they are plants that are usually not native to the area in which they are growing and whose growth is so rapid, dominant, or toxic they out-compete native plants, often taking over complete site or ecosystems over time. They seldom have any natural predators, hastening their spread. They are usually forbs (weeds) but also include grasses (downy brome, crested wheatgrass), shrubs (caragana), and trees (saltcedar, Russian olive).

Noxious weeds alter plant community composition and can be detrimental to ecosystem functions and processes such as nutrient cycling and energy flow. Soil texture can be changed, affecting soil moisture regimes. Serious weed infestations degrade soil stability. Surface runoff and sediment yield can be increased substantially (Lacey 1989).

Noxious weeds most commonly become established in areas where ground-disturbing activities (coupled with import of non-native seed) have occurred and created even very small areas of bare soil, and where a seed source is already present or in some way is brought in to the area. Once established, they often spread into adjacent stands of native vegetation. Areas where

noxious weeds can be expected to occur are road and trail systems, timber harvest skid trails and decking/landing sites, campgrounds, recreation trails and trailheads, areas of livestock concentration, concentrated wildlife use areas such as wintering grounds, utility corridors, mineral developmental sites, water transportation ditches, and stream systems.

An environmental assessment for Management of Noxious Weeds on the Bighorn National Forest, completed in 1998, uses an integrated management approach: manual and mechanical treatments, herbicide application, and use of biological agents (such as insects and goats) (USDA Forest Service 1998). Management and control efforts are conducted by Forest employees, as well as through cooperative efforts with Bighorn, Washakie, and Johnson County Weed and Pest Control Districts. They are guided by application of integrated weed management principles, and follow direction set forth in the *USDA Forest Service Guide to Noxious Weed Prevention Practices*. Prevention and education efforts have been stepped up recently, both for members of the public as well as for Forest employees.

The following summary of noxious weed species present on the Forest was taken from the Bighorn National Forest Noxious Weed Management Environmental Assessment (June 1998), Appendix E. It shows a total of 9 species infesting 14,762 acres of the Forest.

Table 3-49. Noxious weed species on the Bighorn National Forest.

	Buffalo/Tensleep	Tongue	Paintrock	Medicine Wheel	Forest Total
Canada thistle	1,841	7,623	411	1,078	10,953
Houndstongue	3,347	4.5		28	3379.5
Musk thistle	< 1		1	28	29
Russian knapweed		7	103	1	111
Hoary cress (Whitetop)	Suspected		144		144
Leafy spurge		4.5			5
Yellow toadflax	100				100
Spotted knapweed	Suspected		1 +		1
Russian olive			40		40
District totals	5,288.05	7,639	699	1,135	
Forest Total					14,762

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Based upon the 1985 Bighorn National Forest Land and Resource Management Plan (1985 Forest Plan) direction, treatment of noxious weeds is to be implemented in the following priority:

1. Leafy spurge, hoary cress (whitetop), yellow toadflax, and Russian knapweed.
2. Invasion of new plant species classified as noxious farm weeds.
3. Infestation in new areas.
4. Expansion of existing infestations of Canada and musk thistle, and other noxious weeds.
5. Reduce acreage of current infestation.

Numerous additional species have since been observed and made priority for treatment on the Forest, including yellow toadflax, ox-eye daisy, and the knapweeds. The following is a summary of species and acres treated by county in year 2002.

Table 3-50. Noxious weeds targeted and treated on the Bighorn National Forest by county.

Species	Bighorn County		Washakie County		Johnson County		Sheridan County	
	Targeted	Treated	Targeted	Treated	Targeted	Treated	Targeted	Treated
Spotted knapweed (<i>Centaurea maculosa</i>)	Yes	Yes	Yes	Yes	Yes		Yes	Yes
Leafy spurge (<i>Euphorbia esula</i>)			Yes		Yes	Yes	Yes	Yes
Diffuse knapweed (<i>Centaurea diffusa</i>)	Yes	Yes			Yes			
Houndstongue (<i>Cynoglossum officinale</i>)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Common tansy (<i>Tanacetum vulgare</i>)	Yes	Yes	Yes		Yes			
Hoary cress or Whitetop (<i>Cardaria draba</i>)	Yes	Yes	Yes		Yes			
Yellow toadflax (<i>Linaria vulgaris</i> L.)			Yes	Yes	Yes			
Russian knapweed (<i>Centaurea repens</i> L.)	Yes	Yes	Yes		Yes			
Common burdock (<i>Arctium minus</i>)	Yes	Yes	Yes		Yes	Yes	Yes	Yes
Canada thistle (<i>Cirsium arvense</i>)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Musk thistle (<i>Candus nutans</i>)	Yes	Yes	Yes		Yes	Yes		
Common mullein (<i>Verbascum thapsus</i>)	Yes	Yes	Yes		Yes	Yes		
Wild licorice (<i>Glycyrrhiza lepidota</i>)	Yes	Yes				Yes		

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Species	Bighorn County		Washakie County		Johnson County		Sheridan County	
	Targeted	Treated	Targeted	Treated	Targeted	Treated	Targeted	Treated
Bull thistle (<i>Cirsium vulgare</i>)	Yes	Yes				Yes		
Absinth wormwood (<i>Artemisia absinthium</i>)	Yes	Yes						
Chickory (<i>Cichorium intybus</i>)	Yes	Yes						
Dalmatian toadflax (<i>Linaria dalmatica</i>)	Yes	Yes						
Field bindweed (<i>Convolvulus arvensis</i>)	Yes	Yes					Yes	Yes
Hemp dogbane (<i>Apocynum sp.</i>)	Yes	Yes						
Milkweed (<i>Asclepias speciosa</i>)	Yes	Yes						
Ox-eye daisy (<i>Chrysanthemum leucanthemum</i>)	Yes	Yes						
Perennial sowthistle (<i>Sonchus arvensis</i>)	Yes	Yes						
Russian olive (<i>Elaeagnus angustifolia</i>)	Yes	Yes						
\$\$Contributed through cooperative agreement	\$25,000		\$15,000		\$8,500		\$1,200	
Total acres treated (gross)	22,000 (est)		14,964		1,970		320	
Total acres treated (net)	306.85		210.5		60.2		8	

Prevention

Preventing spread of noxious weeds begins with efforts to manage the resource for healthy plant communities, through application of appropriate and sound practices for grazing, prescribed fire, timber management, and recreation. This is more likely to result in and maintain weed-resistant plant communities.

Noxious weeds are introduced and spread in any number of ways: spring runoff, wind, wildfire, birds, big game and other wildlife, livestock, seeds and plant parts brought in or transported during road maintenance, fire control, and timber harvesting equipment; innocent gardeners trying an attractive new variety in their flower bed (yellow toadflax, ox-eye daisy, chamomile, purple loosestrife); and recreationists and recreational vehicles of all kinds. Because of the wide array of spread vectors, it is important to have an active program of prevention.

All Forest activities will be planned and conducted in consideration of the USDA Forest Service Guide to Noxious Weed Prevention Practices, Version 1.0, dated July 5, 2001. Examples of the preventative practices include reseeding efforts after ground-disturbing activities such as fire, road construction, and timber harvest now require the use of seed (and mulch) to be free of noxious weed seed or plant parts. Fire-fighting equipment coming in from all over the country

now routinely are washing undercarriages at municipal or portable wash stations. Timber sale contracts require similar cleansing of equipment coming in from areas known to contain noxious weed populations.

New and expanding noxious weed populations in the Cloud Peak Wilderness are of a particular concern since these weeds can dominate native plant populations and compromise wilderness character and resource values of the area.

Weed-Free Forage Program

Recreational horse use is a possible source of spread, especially in stock use areas such as the Cloud Peak Wilderness. Many horse users bring in hay for feed. Because new populations of noxious weeds can start from seed or plant parts in hay, the Regional Forester in 2005 signed a Weed-Free Forage order that covered the Bighorn National Forest. It restricted “possessing, storing, or transporting of any hay, straw, mulch, or forage product which has not been certified as free of noxious weeds and seeds.” The Weed-Free Forage order, originally signed in 1997, has been considered successful in reducing new infestations of noxious weeds.

Roadside Monitoring and Treatment

Perhaps the most common source of weed expansion occurs along highways and Forest travel ways, particularly those used for motorized travel. Because of this the Forest will maintain a program of frequent roadside monitoring as a preventative measure.

Weed Education and Awareness

Informing people as to the identity, methods of spread, undesirable/dangerous results, and means of prevention of noxious weeds in ecosystems remains the single most effective way to prevent or control expansion of non-native plants on the Forest.

The number of species of noxious weeds on the Bighorn National Forest has increased since preparation of the 1985 Forest Plan. Forest records indicate that county treatment today requires less chemical than in the past, indicating that many populations are smaller in size. New species and locations are mapped when they are located, and acreages of old populations are updated as they are treated. An updated forestwide inventory has not been conducted since preparation of the Bighorn National Forest Noxious Weed Management Environmental Assessment (June 1998).

Non-Plant Invasive Species

Non-native fish species are widely distributed across the Forest. Competition with non-native species is one of the leading causes for the decline of native Yellowstone cutthroat trout. Invasive species education efforts should also include information on the detrimental effects that non-native fish species such as rainbow trout (*Oncorhynchus mykiss*) and brook trout (*Salvelinus fontinalis*) can have on Yellowstone cutthroat trout. Current efforts should focus on education and restoration of native aquatic species.

Whirling disease and New Zealand mud snail are not known to be present on the Forest at this time. However, either or both could be introduced to waters in the future. Current efforts should focus on education and detection of these aquatic invasive species.

ENVIRONMENTAL CONSEQUENCES

General Effects

Noxious weeds and other invasive plant species most commonly become established where ground-disturbing activities have created areas of bare soil and where a seed source is present. They are introduced or spread in countless ways by people, vehicles, animals, birds, wind, water, fire, and more.

Treatments for the life of this plan will be directed through the USDA Forest Service Guide to Noxious Weed Prevention Practices, as well as implementation of the noxious weed management plan for the Bighorn National Forest.

Despite prevention and eradication efforts, some noxious weed species (such as Canada thistle) will almost certainly continue to persist, across all alternatives, due to their tenacity and the presence of existing populations. For species such as this, the Forest will continue a containment strategy, attempting control the plant in selected areas strategically chosen to minimize spread of the plant. However, other species (such as leafy spurge and oxeye daisy) that currently occupy limited areas will be managed under an eradication strategy to stop the spread to the extent possible. For these species, complete control will be the emphasis wherever they are found.

The Forest is expending weed control funding through county programs to control weed species on adjacent private lands (through authority in the Wyden Amendment). Still, existing noxious weed populations will likely continue to spread between adjacent or intermingled private and other agency lands. Similarly, populations from other-ownership lands will continue to spread onto the Forest.

Alternatives that allow greater amounts of human presence and human-caused disturbance, and/or that allow the greatest amounts of natural soil disturbance, will generally provide more opportunity for noxious weed species to be introduced and for existing populations to expand. Alternative C allows for the least cumulative alteration of landscape and activity and can be expected to have the least effect from noxious and invasive species. Alternatives with more cumulative activities in order from the least to the most are Alternative B, A, D-DEIS, D-FEIS, and E. Alternatives B, A, D-DEIS, and D-FEIS all have moderate potential for expansion, while Alternative C has the least and Alternative E has the most.

Direct and Indirect Effects

Effects from Category 1 Management Areas: Since these areas are less accessible and often receive less use by the public than other areas of the Forest, noxious weed infestations are less common and less extensive, but can be more difficult to find and treat. Noxious weed populations in the Category 1 management areas and proposed areas have resulted from natural and man-caused disturbances, or result from noxious weed seed carried in by those recreating, livestock permittees, outfitters, wildlife, or others. The weed-free hay closure order for the Bighorn National Forest provides a mechanism for limiting spread of noxious weeds by those using pack and saddle stock. No such protection is in place to mitigate impacts from other Forest users.

Treatment of weed populations in these areas must often be accomplished without the use of motorized or mechanized equipment, and can be in areas difficult to access. Herbicide treatment may be accomplished with backpack pumps or can be aided with the use of pack and saddle stock. Hand grubbing is an option but can be time consuming and costly for extensive infestations; it is not usually effective for the deep-rooted, perennial, rhizomatous weeds.

Alternative C has the greatest amount of area designated in Category 1, with Alternatives D-FEIS, B, A, D-DEIS, and E following sequentially.

Effects from Research Natural Area Management: RNAs tend to experience less use by people and less associated disturbances than other areas. They are often difficult to access. Generally, the opportunity for introduction and spread of noxious weeds is lower than in many other areas. Similar to Category 1 effects above, treatment can be difficult and costly.

Alternatives B, C, and D-DEIS have the most acreage allocated to MA 2.2, with identical new RNA designations: Mann Creek, Leigh Creek, Pheasant Creek, and Lake McClain.

Alternatives A and E have no additional RNAs proposed. Alternative D-FEIS proposes to add Mann Creek and Leigh Creek to the RNA system.

Effects from Management of Special Interest Areas (Medicine Wheel), management prescription 3.1 or Medicine Wheel National Historic Landmark and Vicinity,

Management Prescription MW: In these areas, many uses (e.g., grazing, camping, timber management, commercial use) are managed with special consideration for the historical and cultural values, and the area is to be managed to appear natural. Opportunities for new or spreading noxious weeds should be relatively few, as no new road construction or timber harvest activities are planned. The impact will be the same across all alternatives.

Effects from Timber Management: Activities associated with timber harvest involve high amounts of human presence; they create areas of disturbed or bare soil, and very commonly result in expansion or introduction of noxious weed populations. Skid trails, decking and landing sites, and areas treated with dozers or roller-choppers for reforestation efforts all create opportunities for noxious weed infestation or expansion. Motorized transportation is common, and potential for spread of noxious weeds is great. Prevention measures can help reduce this effect. Timber sale contracts require cleansing of equipment. Any reseeding efforts require the

use seed (and mulch) free of noxious weed seed. The order of alternatives with timber harvesting activities, from least to most, is: C, B, D-DEIS, D-FEIS, A, and E.

Effects from Category 8 Management Areas: Ecological conditions are likely to be permanently altered in these areas beyond the level needed to maintain natural-appearing landscapes and ecological processes. Human activities are generally commercial in nature, and motorized transportation is common. Potential for ground disturbing activities and introduction/spread of noxious weeds is great. Infestation areas can be readily monitored and treated, but early detection and eradication is crucial.

While the acres allotted to Category 8 management prescriptions vary slightly between alternatives, the overall proportion of these acres to the total acres on the Forest is so small that there is no difference in the effects on invasive species.

Effects from Fire and Fuels Management: Wildfire and prescribed fire have a great potential to spread noxious weeds because of the human activities, motorized transportation, potential for ground disturbing activities, and large number of acres that can be affected. Wildfires, suppression activities, and prescribed burning can create areas of bare soil and areas of reduced vegetation cover, both of which provide ideal conditions for noxious weeds to spread rapidly, especially if populations already exists in or adjacent to a burned area.

Because of the presence of abundant seed of Canada thistle in most landscapes, wildfire will likely continue to create large increases in new populations of this species. Where eradication is not possible spread will be minimized by managing for a healthy native plant community, and by carefully managing fire rehabilitation efforts.

Suppression and support equipment and crew vehicles can carry weed seeds and plant parts. Alternatives A through E include provisions for washing fire-related vehicles to reduce chances of carrying noxious weed seed; the No Action Alternative does not have a similar provision. Prescribed fires are less likely to spread noxious weeds because they take place under planned and controlled conditions. As more acres burn by wildfire, the risk of spreading existing and new noxious weed populations increases. Differences in wildfire risk and prescribed fire between alternatives will be minimal.

Effects from Recreation and Travel Management: Recreational activities may be responsible for the greatest spread of noxious weed populations because of the number of people with their vehicles, horses, and accessories that visit the Forest, and the wide area they cover. Noxious weed expansion is most likely to occur along roads and trails. Once established along the travelway, if left untreated, the populations begin to spread laterally from the travel corridor. Some expansion occurs at trailheads and popular horse-camping areas. Weed seeds and plant parts are brought in on vehicle undercarriages and tires, off-road vehicles, horse trailers, hay and feed products, boots and shoes, camping and fishing equipment, etc. Any activities that create bare or disturbed soil provide conditions for invasive species establishment and spread in areas including roads and roadsides, trails and trailheads, parking lots, developed and dispersed camping sites, popular fishing locations, heavy-use areas around summer homes, ski runs, and construction areas. Off-road vehicle travel has high potential to introduce and spread noxious weeds.

CHAPTER 3 AFFECTED ENVIRONMENT & ENVIRONMENTAL CONSEQUENCES

The weed-free forage special order provides a mechanism for limiting spread of noxious weeds by those using pack and saddle stock. Since no such protection is in place for motorized vehicles, alternatives that allow for greater levels of motorized travel (in summer) are likely to provide greater opportunity for spread of noxious weeds.

Road decommissioning (with monitoring) reduces the areas populated by noxious weeds.

All action alternatives limit motorized travel to designated routes, and as a result limit potential spread of noxious weeds more than the no action alternative. The motorized summer recreational opportunities vary from highest to lowest by alternatives follows: E, A and D-DEIS, D-FEIS, B, and C.

Effects from Heritage Management: Effects from managing heritage resources are anticipated to be very minor in scope or acreage. If known sites are evaluated for possible nomination to the National Register (involving soil disturbance through pit evacuations, for example), noxious weed seed could be brought in, resulting in introduction or spread of noxious weeds. Effects from managing heritage resources will be consistent across all alternatives.

Effects from Mineral and Energy Development: Effects are similar to those for recreation, described above, if mineral operations result in exploration activity and if sites go into production and result in an increase in travel. Production sites (including frequent presence of maintenance vehicles) often create areas of disturbed soil, providing areas for noxious weed infestations. Restoration of these areas following production will involve monitoring and treatment of noxious weeds. The potential for these activities is very small based upon past activity levels on the Bighorn National Forest. There is nothing in this analysis that indicates an increase in future levels of development. Effects will be consistent across all alternatives.

Effects from Utility Corridors: Installation of overhead voltage lines and buried electric, cable, telephone, or other utility system lines creates areas of bare soil and effects similar to Mineral and Energy Development above. These areas are generally subject to permit provisions that include monitoring and treatment for noxious weed infestation and spread, but they can become problem areas. Effects will be consistent across all alternatives.

Effects from Livestock Grazing and Big Game Use: The majority of permitted livestock are cattle, sheep, and horses. They can introduce noxious weeds by transporting seeds in their hooves, hair/wool, or in digestive systems. Horses and sheep in particular are known to consume several species of noxious weeds after plants are mature and produced viable seed. Big game animals can also introduce and spread noxious weeds in the same way that domestic livestock can.

Horses used by outfitters/guides can also be a source of weed delivery from infested private lands, and new populations can be started at their camps and in the areas and along trails they are permitted to use. Special Use Permit clauses require that operators comply with the regional weed-free hay closure order.

Livestock can also be used as a very effective control method for some noxious weeds. Goats are the most notable example. Having been trained to prefer certain species, they are extremely effective in reducing leafy spurge. Cattle are effective in reducing Canada thistle populations in

some areas, as they prefer to graze the plant just as it begins to flower, thus preventing seed set. Effects from managing livestock will not differ significantly between alternatives.

To the extent that big game animals transport noxious weed seed, less would be transported where big game migration is decreased or eliminated. This could conceivably occur in cases where wildlife winter range is enhanced. Management prescription 5.41, deer and elk winter range, varies from greatest to fewest acres in Alternatives D-FEIS, E, D-DEIS, B, A, and C.

Effects from Rangeland Vegetation Management: Projects that have potential to create areas of bare soil, such as prescribed fire in aspen or ponderosa stands or mechanical treatment for conifer encroachment, create the possibility of introducing or expanding noxious weed populations; in such cases, mitigation is required to prevent or control weed populations.

The combined acres of vegetative treatment for rejuvenating aspen, maintaining native meadows, and treating sagebrush and other shrublands and associated noxious weed spread will remain relatively constant across all alternatives.

Effects from Lands Exchanges: An individual land exchange could result in a potential loss or gain of noxious weed infestations on the Forest, depending upon the size and location of the exchange and whether either the offered or selected lands contained existing populations. If an exchange results in a subdivision, or development where human activity will be greatly increased, the likelihood of new infestations of noxious weeds will also be greatly increased. The effect from possible land exchanges will be consistent across all alternatives.

Effects from Wildlife and Fisheries Management: Wildlife species can transport noxious weed seeds in the same ways livestock can. Some species of birds make it possible for plant seeds to germinate by first passing through their digestive tracts; in such instances, the seeds are unable to germinate without going through this scarification process. Animals may collect and store weed seeds such as thistles, contributing to expansion of populations as they germinate in future years. Wildlife or fisheries enhancement projects that disturb the soil surface (such as fish structures) can increase weed populations. The effect from wildlife and fisheries management will be consistent across all alternatives.

Effects from Threatened/Endangered/Sensitive Species Management: In general, the habitat requirements in and around each known or discovered TES species location will be protected, restored, or enhanced. It is conceivable that habitat needs for a specific species could require actions (and possible ground disturbance) to manage for early seral conditions that could have potential for increased noxious weed invasion. The effect from threatened, endangered, and sensitive (TES) species management will be consistent across all alternatives.

Effects from Species Viability Management Requirements: Effects would be similar as for TES species management stated above, including any efforts that may involve ground-disturbing activities. The effect from species viability management will be consistent across all alternatives.

Effects from Soil and Watershed Management: Soil and watershed restoration or improvement projects are intended to improve condition of the land, that is, to repair or restore areas of disturbed conditions. There could be a greater disturbance to the land in the short run

as a project/treatment is implemented, which could also increase the possibility of noxious weed expansions. In the long run, however, there should be an overall reduction in areas of bare soil. The effect from soil and watershed management will be consistent across all alternatives.

Cumulative Effects

The cumulative effects table at the beginning of this chapter includes the list of past, present, and reasonably foreseeable future activities that were considered with regard to cumulative effects to invasive species. This discussion considers effects of invasive species since their first appearance on the Bighorn National Forest through the next planning period (estimated at 15 years). It considers effects of invasive species on the Forest, and in the adjacent 4 county area. The key indicators for invasive species analysis are amount (acres) of invasive species and the amount (acres) of treatment.

Amount (acres) of Invasive Species

On and off the forest, noxious weeds and invasive plant species often become established where ground-disturbing activities have created areas of bare soil, and where a seed source is present. Bare ground has resulted from past activities including livestock grazing, timber harvest, recreation, and road/trail development. Seed sources have included recreational livestock, permitted livestock, and motorized vehicles. Their populations have increased throughout the four counties. The county weed and pest districts map noxious weed occurrences, and their maps show the amount and type of invasive species.

Expectations are that the amount of invasive species on and off the Forest will increase as the population of local communities increases, ‘baby-boomers’ retire, and as more people nationwide continue to seek places like the Big Horn mountains to recreate and retire. ATV use in particular has seen a dramatic increase recently that is expected to continue although the rate of growth is not likely to be as dramatic as it has been in the past decade (See Specialist Report for Recreation). The state-sponsored OHV program may result in increases in ATV use across the Forest. Locally, the current coalbed methane activity in the Powder River Basin has resulted in more demand for recreational use of the Bighorn National Forest, particularly for motorized uses, and this activity is expected to continue (BLM, 2003). The coalbed methane ground disturbing activities of pipeline burial, road construction, and well pad development will increase the risk of invasive species spread off-Forest, and could lead to spread on-Forest.

Noxious weed populations on Forest can be directly influenced by activities on adjacent lands, and vice versa. For this reason it is critical that cooperative efforts continue in these areas, and with county and state efforts at education and control. As more travelers come from out of state, certification and treatment becomes increasingly important in noxious weed management on-Forest. Urbanization is expected to continue to result in spread of invasive plant species off Forest. As new residents come to communities adjacent to the Forest, education and control become increasingly important. Watercourses are important vectors for invasive species, and since the National Forest System lands are at the head of the watersheds, Forest invasive species populations could spread to non-Forest land via this avenue.

Acres of Noxious Weeds Treated

The Forest is expending weed control funding through county programs to control weed species on adjacent private lands (through authority in the Wyden Amendment). Management and control efforts are spearheaded by cooperative efforts with Bighorn, Washakie, and Johnson County Weed and Pest Control Districts, and follow direction set forth in the USDA Forest Service Guide to Noxious Weed Prevention Practices. The Weed and Pest Districts work closely with private landowners and other USDA agencies and County Conservation Districts to treat existing populations, and to educate people on the topic of invasive species. Prevention and education efforts have been stepped up, both for members of the public as well as for Forest employees.

Alternatives that allow the least ground disturbing activity and that discourage or make difficult human presence and activity will result in the least risk of noxious weed spread. Alternatives with the least to greatest area in Management Prescription Categories 1 and 2 are Alternatives E, A, D-DEIS, D-FEIS, B, and C.

Vegetation

Introduction

The ecosystems and vegetation of the Bighorn National Forest are dynamic. The processes of succession and disturbance patterns have produced the current vegetative conditions. These natural processes, both part of and necessary for ecosystem function, will continue to produce changes in the future. Therefore, the following descriptions of current vegetation represent only one point in time. Some of the changes will be generally predictable, others less so. Accordingly, any description of future vegetation will be a prediction subject to uncertainty. The level of uncertainty depends on the degree to which natural processes are allowed to operate. Natural disturbance events such as fire, windstorms, landslides, and insect and disease outbreaks are generally difficult to predict. On the other hand, changes associated with succession and human-caused disturbance such as logging and prescribed burning are fairly predictable. Although the Forest will experience natural disturbance events, the degree to which they are allowed to occur will influence the ability to predict future vegetative conditions at any given point in time.

Legal and Administrative Framework

National Forest Management Act of 1976 (NFMA)

Code of Federal Regulations (CFRs) 36

- 217 Requesting Review of National Forest Plans and Project Planning
- 219 Planning
- 221 Timber Management Planning
- 222 Range Management
- 241 Fish and Wildlife

Policy direction from the Forest Service Directives System in Forest Service Manuals (FSM) 2400 Timber Sale Management, 2200 Range Management, and 2600 Wildlife Management, and in Forest Service Handbooks (FSH) are listed here but not limited to:

- R-2 Rangeland Analysis and Management Training Guide
- Timber Resource Planning Handbook
- Timber Management Information System Handbook
- Timber Sale Administration Handbook
- Silviculture Practices Handbook
- Timber Sale Preparation Handbook
- R-2 2409.26 Silvicultural Practice Handbook

2609.13 Wildlife and Fisheries Program Management Handbook

Resource Protection Measures

There are numerous forestwide and management area prescription standards and guidelines that apply to vegetation. All alternatives provide for satisfactory regeneration of logged areas, for treatment of activity-related fuels, management of insects and diseases, and various wildland fire management strategies.

AFFECTED ENVIRONMENT

Forest Vegetation

Composition

Vegetation on the Forest has been classified into several types, including both forest and non-forest types. The descriptive names used are based on the major species found in the type. Many species, other than those listed, also occur in each type. Cover types for the Forest, their acreages, and the percent of the total Forest are listed in the following table.

Table 3-51. Percent of cover types on the Bighorn National Forest (acres rounded to hundreds).

Cover Type	Acres	Percent of Bighorn
Forest Cover Types		
Lodgepole pine	346,074	32%
Spruce/ fir	234,754	21%
Douglas-fir	100,294	9%
Ponderosa Pine	18,671	2%
Limber Pine	14,214	1%
Aspen	10,290	1%
Juniper	2,943	<1%
Cottonwood	409	<1%
Total forest Cover Types	727,240	66%
Non-Forest Cover Types		
Grass	136,983	12%
Non-Vegetated (Bare, Rock)	97,150	9%
Forb	62,517	6%

Cover Type	Acres	Percent of Bighorn
Sagebrush	55,067	5%
Other Shrubs	17,557	2%
Total Non forest	369,275	34%
Total	1,096,515	100.0%

Source: Bighorn GIS, (USDA Forest Service 2003c).

Major Cover Types on the Bighorn National Forest

Lodgepole pine (*Pinus contorta*)

Lodgepole pine is the major tree type on the Forest, occupying 32% of the land area. It is the dominant species in the subalpine forest. Under natural succession, a spruce-fir climax association would eventually replace many lodgepole pine areas. In certain locations, however, lodgepole pine can form climax associations.

Lodgepole pine does not grow well in shade. It rapidly occupies sites disturbed by logging, fire, or other major ground disturbing activities. Young lodgepole pine stands are often found in a very dense stagnated condition. If the stand stagnates for too long, the trees will remain small until a stand-replacing event removes them. Stand-replacing events include fire, blowdown, insects, disease and timber harvesting. Mature trees can be found in thick, dense stands or open, sparse stands.

Lodgepole pine is a relatively short-lived species, and trees older than 200 years are rarely found. This is because of the frequency of stand-replacing events such as fire typical of this series. Lodgepole pines have two cones types:

- ◆ Serotinous cones stay closed until exposed to temperatures high enough to open the cone. This usually occurs during fires or when exposed to full sunlight on the forest floor.
- ◆ Non-serotinous cones open when the cone reaches maturity. With seed dispersed every year, and good seed years averaging every 7 years.

The difference between the two is important when regenerating the species. Where the majority of the cones are serotinous, care is taken to protect these cones, as there is no future cone crop to rely on for a seed source. Any regeneration treatment must also plan for increasing cone temperatures, either through broadcast burning or solar heating, so the cones will open. Stands that have typically been regenerated naturally by wildfire will have a larger percentage of serotinous cones than other stands (Lotan 1974).

The lodgepole forest is highly important in providing scenic quality, watershed protection, wildlife habitat, and wood products.

Engelmann spruce (*Picea engelmannii*)/Subalpine fir (*Abies lasiocarpa*)

The mixed forest series of Engelmann spruce and subalpine fir occupies 21% of the Forest.

It can be found in the alpine tundra region as well as down to the upper montane forest region. This series represents the climax association for most of the subalpine forest. Without further disturbance such as windthrow, insects, disease, or fire, it would replace lodgepole pine over many acres through natural plant succession. Engelmann spruce life span averages 350 to 400 years while subalpine fir trees over 250 years old are rare. Both species can reproduce in their own shade with spruce also able to regenerate on open mineral soils. These forests often form multi-aged stands. Subalpine fir is the most shade tolerant tree species on the Forest. Both species are highly vulnerable to windthrow because of their shallow root systems. They are also vulnerable to various wood rots, as they age.

The spruce-fir forest is highly important in providing scenic views, watershed protection, wildlife habitat, and wood products.

Douglas-fir (*Pseudotsuga menziesii*)

While only occupying about nine percent of the Forest, the Douglas-fir series is more important than its area implies. Typically occurring on steep, north-facing slopes at lower elevations, Douglas-fir occurs in pure stands or in combination with ponderosa pine, aspen, or lodgepole pine. Douglas-fir reproduces best under partial shade and does not tolerate either thick dense canopies or completely open sites well.

This long-lived species has high value for wildlife habitat, scenic quality, and watershed protection. The Forest has not harvested Douglas-fir extensively in the past resulting in mostly mature and overmature stands.

Douglas-fir and ponderosa pine are often intermixed with the more tolerant Douglas-fir able to regenerate under a canopy better than the less tolerant ponderosa. Without further disturbance such as windthrow, insects, disease or fire; Douglas-fir would replace ponderosa pine over many acres through natural plant succession. However, because the Douglas-fir branches close to the ground, it is considered a ladder fuel taking ground fires to the crowns of trees.

Ponderosa pine (*Pinus ponderosa*)

Ponderosa pine occupies almost two percent of the Forest. At its upper elevational limit, it borders the subalpine forest region of lodgepole pine, Engelmann spruce, and subalpine fir. At the lowest elevational limit, it borders the short-grass prairie. Thick bark on older, large trees makes them resistant to fire. Ponderosa pine foliage can have very low moisture content during hot weather and droughts. Where tree crowns are not separated from the understory vegetation, fire can burn into the tree crowns and cause extensive mortality in stands.

A diverse ponderosa pine forest provides wildlife habitat for many species. It is winter range for deer and elk. Young ponderosa stands are often very dense which can lead to stagnation. Mature stands typically grow in open park-like stands with well-developed shrub and herbaceous under-stories. The leading causes of mortality are: disease, insects, fire, and windthrow.

Ponderosa pine is moderately shade intolerant, and young ponderosa are often out-competed in the understory by the more fire susceptible Douglas-fir. Historically this covertime had short interval low intensity fires that would thin younger pine, and remove the more tolerant Douglas-fir. However, with over 100 years of fire suppression, much of the ponderosa covertime has become denser and is being converted to the more shade tolerant Douglas-fir.

Limber pine (*Pinus flexilis*)

Limber pine stands are found on just over 1% of the Bighorn National Forest and may be found as a component of the series above. Limber pine is known as a tree of high cold windy ridges, growing on sites where other trees can't grow. The seeds are large and lack wings, being primarily distributed and utilized by wildlife. Limber pine is an effective pioneer and colonizes disturbed and harsh sites. It is very slow growing reaching heights from 30 to 50 feet (Harlow and Harrar 1969). The introduction of the exotic disease white pine blister rust, *Cronartium ribicola*, is dramatically reducing the population of this species, and is discussed further in the insect and disease section.

Aspen (*Populus tremuloides*)

The aspen series, noted for its brilliant fall colors, occupies about 1% of the Forest. It typically occurs mixed in with grasslands, meadows, mountain brush, or other forest series. Aspen contribute to wildlife habitat, watershed protection, and scenic quality. The aspen on the Forest are typically mature to overmature with a high level of decay, disease, mortality, and succession by conifers.

Aspen regenerates almost entirely through root sprouting. To stimulate root sprouting, most aspen clones require a major disturbance that removes most or all of the existing trees. Wildfire has historically been the primary disturbance initiating root sprouting. The control of wildfire and lack of fine fuels from ungulate grazing on the Bighorn National Forest has permitted most of the aspen stands to become overmature with few means of regeneration. Without disturbance, either natural or man-made, much of the aspen will convert to conifer types within the next rotation, approximately 75 years.

Juniper (*Juniperus species*)

Utah juniper in the Big Horn Mountains is found on the lower western slopes between 1,520 and 2,140 meters on coarse textured soil (Despain 1973). Rocky Mountain juniper (*Juniperous scopulorum*) is a minor component in the moister portions of drainages. Less than 600 acres of the Bighorn National Forest is classified as Juniper Woodland. It is also a component in stands with other cover types, mainly along the lower elevations of the Big Horns.

Structure

Forested ecosystem elements are created in the interplay of succession and disturbance. Succession is an orderly process of biotic community development that involves changes

in species, structure and community processes with time. It is reasonably directional and, therefore, predictable (Schwarz et al. 1976). Forest stands develop recognizable stand structures over time, that can be described in terms of the horizontal and vertical distribution of components including height, diameter, crown layers, and stems of trees, shrubs, herbaceous understory, snags and down woody pieces (Thomas et al. 1979).

Different arrangements of these components provide different conditions that make up the diversity of the forest. Structure and diversity are discussed in the Biodiversity section of this document.

Function

Ecosystem functions deal with energy and material flows within and between ecosystems. Accordingly, ecosystem functions are closely tied to ecosystem processes. Ecosystem processes cause composition and structure to change with time. Conversely, changing composition and structure leads to a change in the processes. It follows that ecosystem functions are also very dynamic, changing over time. Specifically, the functions associated with vegetation are quite complex. For example, nutrient cycling and photosynthetic production change in relation to composition and structure.

Rangeland Vegetation

Rangelands are a major component of ecosystems in the western United States and on the Bighorn National Forest. They are lands that include strong representation by herbaceous and graminoid species. Rangelands include, but are not limited to: grasslands, forblands, shrublands, open-canopied forests, and associated riparian, wetland and aquatic areas. Well-managed rangelands provide forage and cover for wildlife and domestic livestock, in addition to high quality water and numerous recreational values. (USDA Forest Service 1996)

There are a total of 1,112,429 acres within the administrative boundary of the Bighorn NF, 99% of which are National Forest System acres (BNF GIS CVU database 2002). Based only upon vegetation types that are largely grass/forb, 21% (233,046 acres) could be classified as rangelands. In addition, 36% of all vegetative types have 10-34% grass/forb, and provide considerable herbaceous vegetation for various uses. Forty-three percent of vegetative types include 0-9% grass forb components and provide smaller amounts of forage.

Grasslands are scattered throughout the Bighorn National Forest, particularly in the north where fine-textured soils are more widespread. Forb-dominated areas are mostly in the alpine and subalpine meadows. Shrublands containing sagebrush (*Artemisia spp*), juniper (*Juniperus osteosperma*), or curlleaf mountain mahogany (*Cercocarpus ledifolius*) are scattered throughout the Forest, but they occur primarily in the foothills of the western flank (Meyer and Knight 2001).

The majority of shrub cover types on the Forest are sagebrush. Most sagebrush is of the *Artemisia tridentata vaseyana* type, indicative of the high elevations and moisture regimes at elevations on the forest as compared to surrounding basins. This type is also more resilient to

disturbances, since it occurs on more productive sites with more precipitation than those at lower elevations. More of the shrub communities occur on the western side of the range than the east due to climate. Mountain brush communities are the next most abundant, and includes species such as chokecherry, mountain mahogany, snowberry, serviceberry, and others. Due to lack of fire in most of these shrub types, there are fewer communities in an early seral condition than would be expected under historic ranges of variability. The Forest has been conducting prescribed burning in primarily the sagebrush types over the past two decades for the purpose of range forage and wildlife habitat enhancement. These treatments have been localized, such as in Shell Canyon, Horse Creek Mesa, and other sites primarily on the west side of the mountain range. Currently, inventories to determine age class distributions of shrub communities occur at the project level. Similar to forested structural stages, it is desirable to have a balance of age classes to provide for a diversity of wildlife and resilience to disturbance processes such as fire (Thomas and Maser 1986).

The numerous sharp boundaries between grassland and forest are an interesting feature of the Big Horn Mountains, particularly in the northern part of the forest (Despain 1973). Such boundaries appear to be caused by differences in soil texture, with forests occurring on the more coarse soils and meadows on finer textured soils. The physical location of many mountain meadows and grasslands appears to be quite stable (Despain 1973). In some instances, however, changing climatic conditions have allowed tree seedling establishment on areas that were historically occupied by meadows (Meyer and Knight 2001).

Dominant upland (non-riparian/non-wetland) species are Idaho fescue (*Festuca idahoensis*), bluebunch wheatgrass (*Pseudoroegneria spicata*), mountain mahogany (*Cercocarpus spp.*), big sagebrush (*Artemisia tridentata*), and black sagebrush (*Artemisia nova*) (Regan et al. 2003). The extensive montane grasslands of the Bighorn National Forest tend to occur on fine-textured sedimentary soils, mostly at low-elevations with low precipitation (<2,300m) or at high elevations too cold or snow-covered to support continuous forests (2,750 m) (Jack 1900, Despain 1973). Idaho fescue (*Festuca idahoensis*) is the most common grass from 1,840 m to about 3,000 m (timberline); bluebunch wheatgrass (*Pseudoroegneria spicata*), dominates the grasslands at lower elevations. Both grasses also can be found with curl-leaf mountain mahogany and big sagebrush. The relatively high precipitation on the east slope has resulted in more forest than on the west side, even on sedimentary substrates (Despain 1973, Meyer and Knight 2001).

Approximately 104,596 riparian acres occur on the Forest. (FEIS Aquatics and Fisheries) Geomorphology, topography, and other environment attributes influence riparian vegetation community development. Stream channel type, soil characteristics, parent material, landform, and elevation are some of the important factors. Disturbance regimes in riparian areas are more complex than in the uplands because of the stream dynamics associated with riparian areas. Succession usually proceeds slowly and sometimes changes cannot be detected during a person's lifetime (Girard 1997).

Natural disturbances, most often involving water availability, result in riparian succession. Examples are stream flooding, meandering, undercutting, down cutting, sediment deposition, beaver dam building and breaching, and fluctuating water tables (Girard 1997, Clements 1991).

Natural riparian succession can result from disturbance events on upland areas that affect moisture levels in riparian areas such as timber harvest or fire activity. Other disturbance events are human-caused such as livestock grazing, channelization, road and dam construction, and recreation use. Tie hacking had a tremendous influence on some riparian areas in the early 1900s (Girard 1997).

The Bighorn National Forest and the surrounding watersheds have been grazed by wild ungulates for thousands of years (Knight 1994). The large wild ungulate species of interest on the Bighorn National Forest are elk, moose, bighorn sheep, deer (both mule and white tailed), and pronghorn; with elk, mule deer, and moose the major species currently using the Forest. At their present levels, elk, deer, and moose populations have an effect on certain plant communities. Often the most noticeable effects occur on winter ranges (including fall and spring transition ranges) and in the higher elevations on the highly preferred plant communities such as aspen and willow. Plant reproduction and long-term health are influenced.

The long-term effects of large wild ungulates in some areas has the potential to influence growth, form, reproduction, and long-term health of vegetation if their densities become high enough in a given location. Once livestock enter an area, the combined utilization of the two animal groups can continue to increase effects to resources.

The most commonly recognized effects of large wild ungulates include:

- ◆ Impacts on fall, winter, and spring range as animals migrate seasonally across elevation zones. Large concentrations of animals on wet soils can cause trampling or displacement damage and uproot grass plants. Due to the nutritional needs of these animals, palatable shrub and tree (aspen) species that provide the highest nutritional value are the focus of browsing and grazing. Effects can be severe locally in highly preferred areas and migration corridors or can be minimal in areas little used by the wildlife.
- ◆ Impacts on summer ranges include grazing and browsing impacts on aspen, riparian, and wetland vegetation. Effects can include trampling of wet soils and excessive browsing of hardwood species. Long-term effects can be reductions in vigor or reproductive ability of plants and changes in species composition and cover.

Livestock grazing throughout the Forest occurred at a heavy level from the late 1800s through the mid-1900s. Impacts from livestock can be similar to those of wildlife, they also can be concentrated, and they may impact the same areas year to year. A variety of factors have led to the adjustment of livestock numbers to more sustainable levels in recent decades (Regan et al. 2003, Meyer and Knight 2001).

These effects can be compounded or even masked by similar effects of livestock grazing and browsing. When both classes of ungulates make use of the same plant species and habitats, the effects are often magnified.

There is considerable controversy surrounding domestic and wildlife grazing. Anecdotal evidence from Bighorn National Forest land managers, along with limited monitoring data, indicates that there are localized problems with excessive use of certain plant species and communities. Solutions to these problems are dealt with in communications and coordination

with Wyoming Game and Fish Department biologists and at the site-specific level of NEPA analysis during allotment management planning.

The Forest Service implements management of rangelands through a wide variety of practices as appropriate to the site-specific situation. For example, domestic livestock are managed through term grazing permits on suitable lands that are parts of grazing allotments. Impacts of vehicular use can be dealt with through travel management. Wildlife impacts and recreational stock are often challenging to manage. The state of Wyoming is directly responsible for managing wildlife populations, but the Forest Service is a managing partner for population numbers, diversity, and species viability through the management of rangeland vegetation. Forest Service rangeland management specialists and wildlife biologists coordinate and cooperate with state biologists to maintain big game herds at levels consistent with available habitat and vegetation objectives. In some instances, appropriate management or restoration activities may include revegetation with native species, use of prescribed fire, removal of invading conifer or shrubby vegetation, etc.

Rangeland Suitability

Rangeland suitability analysis for livestock grazing on the Forest was completed following the standard process provided in the Region 2 Planning Desk Guide. Definitions of rangeland capability and suitability can be found in FSM 1905. In brief, rangeland capability considers land potential, while rangeland suitability deals with the appropriateness of applying certain resource management practices to the land. See FEIS Appendix B for a complete description of the suitability determination for livestock grazing. The following chart displays a summary of the suitability analysis compared to existing grazing allotments on the Bighorn National Forest.

Table 3-52. Acres of land determined as capable for livestock use.

Classification/Description	Acres Deducted	Running Totals
Net National Forest System Acres	-----	1,105,017
Deductions for other than capable acres	-----	1,105,017
Soil types that are dominated by a large percentage of rock outcrop	340,944	764,073
Lands that are not capable of producing 200 pounds of forage per acre	63,347	700,727
Lakes, reservoirs, ponds, and marshes	10,564	690,163
Major rivers within the Bighorn National Forest proclaimed boundary	0	690,163
Perennial streams	1,178	688,985
Roads and highways	3,788	685,197
Slopes greater than 60% (not capable sheep or cattle)	22,022	663,175
Slopes between 41%-60% (not capable cattle)	50,621	

Classification/Description	Acres Deducted	Running Totals
Total capable for sheep grazing	441,842	663,175
Total capable for cattle grazing	492,463	612,554

Table 3-53. Acres of land determined as suitable for livestock use.

Classification/Description	Cattle		Sheep	
	Acres Deducted	Running Totals	Acres Deducted	Running Totals
Net National Forest System Acres	-----	1,105,017	-----	1,105,017
Deductions for other than capable acres	492,463	612,554	441,842	663,175
Deductions for other than suitable acres	0	612,554	0	663,175
Existing canopy cover >70%	474,679	137,875	474,679	188,496
Shell Canyon and Bull Elk Park RNAs that exclude livestock	175	137,700	175	188,321
Developed recreation sites	145	137,555	145	188,176
Range exclosures	2,068	135,487	2,068	186,108
Forage not available due to right-of-way fences and other limitations	873	134,615	873	185,236
Current grazing closures	0	134,615	0	185,236
Threatened, Endangered, and Sensitive Species Closures	0	134,615	0	185,236
Other incompatibilities	0	134,615	0	185,236
Economical Feasibility	0	134,615	0	185,236
Total suitable acres (cattle)		134,615		
Total suitable acres (sheep)				185,235

Table 3-54. Acres determined at the forest plan level as suitable for livestock use.

Classification/Description	Acres Suitable
Total Suitable Determination Acres for Cattle grazing	134,615
Total Suitable Determination Acres for Sheep grazing	185,235

Forage Allocations

Rangelands on the Bighorn National Forest provide forage and cover for domestic livestock and wildlife, in addition to high quality water and numerous recreational values. There are currently 86 grazing allotments on the Bighorn National Forest. Approximately 13% (147,333 acres) of National Forest System lands are outside the boundaries of any kind of allotment. Of the 86 grazing allotments, 10 are vacant (vacant allotments are those for which term grazing permits are not currently issued for livestock use) and represent 5.8% of acres that are in allotment status. Of these 10 vacant allotments, 6 are commonly stocked through annual authorization as a means of providing management flexibility to respond to situations such as fire, drought, or needs to rest areas for a variety of resource reasons. In effect, these allotments operate as “forage reserves.” This leaves approximately 2.2% of the total grazing allotment gross acreage not stocked in most years. (Bighorn National Forest INFRA database 2001)

Based upon rangeland analysis data, the average allotment gross acreage is 41% suitable acres (Bighorn National Forest INFRA database 2001). This is the area on which domestic livestock routinely make use of a portion of the available forage. The remaining area (59%) receives only occasional, incidental, or no use by livestock (for example, lodgepole and ponderosa pine with forage in the under story, steep slopes, areas without available water, and so forth).

Cumulatively, this means that while a majority of the forest is in an active grazing allotment, livestock grazing actively takes place on only about 35% of the Forest. Forage in the remaining balance serves other purposes.

Furthermore, on that 35% of the total Bighorn National Forest actually used by livestock, much will have only minimal or light livestock influences to any appreciable degree. This is because in these areas, standards and guidelines specify the portion of annual vegetation production that may be utilized by livestock and wildlife. In most cases, they are restricted to using on 40% to 50% of the annual forage production, leaving the remainder, generally 50-60%, also available for other uses and values.

Because of variation in palatability and in distribution of livestock across the landscape, actual use in most areas is lower than 45%. If you consider the 45% use-level consistent throughout all grazing allotments, livestock would *have available* for use about 39% (45% use-level times 87% of the Forest in grazing allotments) of annual forage production. The remainder is reserved as habitat for game and non-game species of wildlife, scenic recreational values, litter for protection from erosion and for plant and soil health and sustainability, and other values.

Rangeland Health

Succession is the replacement of one plant community by another (Smith 1980). In the absence of disturbance, succession progresses to a stable terminal community called climax or potential natural community. This somewhat orderly and often predictable process is called natural succession. When disturbance occurs, succession may not reach the climax potential natural community (Girard 1997). The assessment of range condition and trend remains a source of

controversy, despite years of practical experience and discussion (Lauenroth and Laycock 1989, Friedel 1991).

Until the mid 1990s, rangeland health in the form of rangeland condition and trend was assessed on Bighorn NF rangelands by looking in detail at existing plant communities, species composition, vigor, and soil conditions. These were compared to a defined desired composition and cover, and rated according to their relative status along the continuum. Range condition was interpreted through a *Range and Ecological Condition* scorecard specific to the range type, through which a range condition rating was derived. This process was thoroughly described in FSH 2209.21, Rangeland Analysis and Management Handbook (superceded).

Beginning in the mid-1990s with the development of *Region 2 Rangeland Analysis and Management Training Guide*, scorecards were no longer used as the reference for “scoring range condition.” Data describing rangeland vegetation has been collected in a fashion as before (with different protocols), but scored against a desired vegetation condition defined in the Forest Plan or in project-specific NEPA decisions. In addition, a classification of riparian communities on the Bighorn National Forest was developed in 1997, and has been used to describe potential, desired, and existing riparian plant communities. (Girard 1997)

Rangeland condition can be defined as the relative degree to which the present plant community resembles the desired plant community. Trend is the direction of change in vegetation and /or soil over time. It is described as moving toward, remaining static, or moving away from a desired condition or objective. A rangeland is considered to be in satisfactory condition when the desired future condition is being met or short-term objectives are being achieved to move the rangeland toward the desired future condition (USDA Forest Service 1996). A rangeland is considered to be in unsatisfactory condition when desired future condition is not being met or short-term objectives to maintain a rangeland in or move it toward the desired condition are not being met.

A desired condition for rangeland vegetation on the Forest is included in the 1985 Forest Plan which defines goals as “concise statements describing a desired condition,” and lists among its goals the following:

- ◆ Manage all allotments to reach satisfactory range condition by 2000. Satisfactory is defined as good or better range conditions with a stable trend, or fair condition with an upward trend.
- ◆ Manage riparian areas to reach mid to late seral ecological condition with rangeland riparian areas managed to achieve satisfactory or better condition by 2000.

The Bighorn National Forest (along with all national forests) reports rangeland condition on established grazing allotments periodically, through the National INFRA data base, by listing all acres of rangeland vegetation within existing allotments into one of three categories: (1) meeting forest plan objectives, (2) moving toward forest plan objectives, and (3) not meeting or meeting toward forest plan objectives. Verified acres are those on which data has been gathered, assimilated, and summarized. As monitoring and analysis are accomplished, the number of acres in each category is expected to change. On the Bighorn National Forest, acres

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reported annually have most often not been based upon hard data, but rather have been derived from qualitative observations by rangeland management specialists at the district level.

Table 3-55. Summary of Forest Service rangeland condition report (capable rangeland within allotments).

	Verified acres	Estimated acres	%
Area meeting desired condition		47,551	38.34%
Area moving toward desired condition		78,030	
Area not meeting or moving toward desired condition	150	37,819	11.60%
Area of undetermined status	164,001	0	50.07%
Total acres "capable" in INFRA data base = 327,551 acres	164,151	163,400	
Area monitored in this FY		139,411	
Riparian area meeting desired condition	0	1,775	13.17%
Riparian area moving toward desired condition	0	4,417	
Riparian area not meeting or moving toward desired condition	0	7,982	16.97%
Riparian area of undetermined status	32,850	0	69.86%
Total acres "Riparian" in INFRA data base = 47,024 acres	32,850	14,174	
Riparian area monitored in this FY		17,821	

Source: Bighorn National Forest INFRA database.

According to 2002 INFRA data, 38% of all rangeland vegetation on the Bighorn National Forest grazing allotments is reported to be meeting or moving toward desired conditions, 50% is undetermined, and 11% is not meeting or moving toward desired conditions. 150 acres (5% of INFRA capable) are 'verified' as not meeting or moving toward desired conditions. 13% of all rangeland riparian vegetation is reported as meeting or moving toward desired conditions, 69% is undetermined, and 16% is not meeting or moving toward desired conditions. No riparian acres are 'verified' to be "not meeting or moving toward desired conditions." INFRA data indicate that "acres verified" in the various categories represents a small percentage of total acres in allotments, and "acres of undetermined status" represents a high percentage. It also indicates that the goals defined in the 1985 plan were not met.

An example of a site-specific determination of rangeland vegetation condition was reviewed to validate estimates. A riparian inventory of some key areas of the Clear Creek/Crazy Woman watershed (147,000 acres) was completed in 1996, using the riparian classification to determine the potential vegetation of a site and whether it was different from current vegetation. The riparian classification was used to assess whether existing plant communities were 1) close to or at potential, 2) far from potential, or 3) intermediate. Intermediate sites may or may not have been meeting a desired condition, but they were clearly not at potential, nor were they far from potential.

No acreage calculations were produced from these maps, however, relative abundance of the ratings of polygons verified were as follows: 108 total polygons sampled; 67 were close to or at potential, 31 were intermediate, 10 were far from potential. A relatively small portion of the total riparian sites in the Clear Creek/Crazy Woman Creek watershed was sampled. However, the sampling was directed to areas identified as to whether the Revised Plan goal of mid to late seral ecological condition is being met due to natural or anthropogenic disturbances (USDA Forest Service 1997). This inventory indicated that a small part of riparian areas in these watersheds was known to be not meeting the desired condition (mid to late seral), and it is consistent with estimates in the INFRA report discussed above.

Areas not meeting or moving toward desired conditions may fall into this category as a result of natural or human-caused disturbances, both historical and more recent (Girard 1997). They may result from disturbances such as beaver activity, mechanical disturbances such as road construction and their effects in water distribution, or they may result from past or present livestock or other activities. They may represent areas where livestock use may have been frequent, repetitive, and heavy during the summer growing season, and may include parks with gentle terrain, available water and dry soils, or short sections of riparian areas. Some that received heavy historical grazing pressure may not have yet recovered, but they are limited in size relative to overall areas supporting livestock use. Through application of Revised Plan standards and guidelines, and through allotment planning and implementation, these areas are expected to decrease in size and eventually disappear. Instances where trend data demonstrates that management efforts have resulted in riparian vegetation moving toward desired conditions have been identified on various allotments throughout the Forest.

About 47,000 acres of the Bighorn National Forest total acres outside of grazing allotments (active and vacant) were determined to be capable, according to the suitability analysis recently completed (Appendix B). For these acres outside of grazing allotments, very little data is available regarding health of rangeland vegetation. Data such as that described throughout this section is generally collected to assess impacts of livestock grazing, and since these areas are outside of allotments, similar data is not available. Changes in rangeland vegetation in these areas result from prescribed and wild fire (or lack of fire), invasive species introduction and spread, wildlife use, historic livestock impacts, recreation impacts, etc., described in “Environmental Consequences” below, as well as in the Invasive Species report of this DEIS. Areas not meeting or moving toward desired conditions or otherwise outside the historic range of variability likely result from these factors, or other natural or mechanical disturbances, some of which may have occurred long ago and are on sites slow to recover due to short growing season, shallow soils, low productivity, etc.

ENVIRONMENTAL CONSEQUENCES

General Effects

The composition and structure of the Forest will continue to be influenced by the same succession and disturbance processes that shaped it. Accordingly, the vegetation will change with time. Natural disturbance events and succession will continue to be the dominate force of change regardless of alternative. Implementation of any given alternative will influence vegetation by the degree to which natural disturbance events are allowed to operate and according to the levels of various human-caused disturbance events, such as mechanical treatment and prescribed burning.

Succession will continue to move vegetation communities toward a mature condition. However, both natural and human-caused disturbance processes will influence succession on the Forest. The degree to which succession is influenced depends in large part on the magnitude and type of disturbance. Vegetative composition resulting from the interaction between succession and natural disturbance is difficult to predict in anything but general terms.

Forest Vegetation: Vegetation Composition

Direct and Indirect Effects

The composition of the forest vegetation will continue to be influenced by the same succession and disturbance processes. Although the vegetation will change with time, cover types will remain relatively stable. Early seral stages of forest development can only occur from both natural disturbances and land uses. Natural disturbance events and succession will continue to operate regardless of the alternative; however the amount of land upon which natural processes operate as the primary disturbance agents varies by alternative.

Implementation of any given alternative will influence vegetation by the degree to which natural disturbance events are allowed to operate and according to the levels of various human-caused disturbance events, such as mechanical treatment and prescribed burning. The following tables display the allocation of land where natural process will predominate, and the management emphasis.

Management scenarios are similar for many management areas. They can be grouped into areas where natural processes dominate, where limited vegetation management is anticipated consistent with management area objectives, and those where active management is included in the desired future condition. To facilitate the understanding of the consequences of allocation of habitat structure stages, management areas with similar management scenarios (emphasis) have been grouped into primary emphasis categories.

The following table displays the grouping of management areas into primary emphasis categories.

Table 3-56. Management areas for primary emphasis categories

Natural Processes Predominate	Management areas allow for limited Vegetation Management, consistent with MA objectives	Management areas allow for more Active Vegetation Management
MA 1.11, MA 1.13	MA 4.2	MA 5.11
MA 1.2, MA 1.31	MA 4.3	MA 5.12
MA 1.31, MA 1.32,	MA 4.4	MA 5.13
MA 1.5, MA 2.1, MA 2.2	MA 5.41	MA 5.4, MA 5.5
MA 3.1, MA 3.23	MA 8.22, MW	MA 8.1
MA 3.31, MA 3.4, MA 3.5		

The following table displays the allocation by alternative and management area by the above emphasis categories.

Table 3-57. Acres allocated by management areas for primary emphasis categories.

Alternative	Natural Processes Predominate	Management areas allow for limited Vegetation Management, consistent with MA objectives	Management areas allow for more Active Vegetation Management
A	44%	4%	52%
B	60%	16%	22%
C	71%	17%	10%
D-DEIS	43%	14%	41%
D-FEIS	44%	13%	41%
E	24%	4%	70%

Alternative E allocates the greatest amount of land to management areas that allow for more active vegetation management, then in order, Alternatives A, D-DEIS, D-FEIS, B, and then C. Part of the goal of more active vegetation management is to establish more diversity in the forested vegetation by creating a more even distribution of age classes, and to provide a sustainable and even flow of goods and services. A more even distribution of age classes is different than what currently exists on the forest and different than the variation in age classes that would be created exclusively by natural process. This more even distribution of age classes, if and when it is achieved, would be directly reflected in habitat structure stages (HSS) which would tend to follow the same pattern and would provide a sustainable even flow of structural stages and ecological function.

During the past 100+ years, roughly 20% of the Forest has been harvested. All alternatives emphasize natural processes with Alternatives C and B allocating the greatest amount of land to management areas in which natural processes are the primary stand and landscape disturbance agents. In the short-term, this may result in an increase in late successional

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habitat as the existing stands age. In the longer term, as natural processes operate with little restriction, the creation of different habitat structure stages will fluctuate greatly over time and space.

Since wildfires and insects are both influenced by stand structure and drought, the potential exists for a large area of the forest to be subject to large scale events with high risk conditions. The arrangement of late successional habitat may be limited to fire refugia (areas characteristically resistant to fire such as north slopes, riparian areas, etc.) or areas particularly resistant to insects at particular times in the future.

Projecting changes in vegetation structure and composition over time is an important part of predicting the environmental consequences of changes in the occurrence and distribution of ecosystem aggregates and in the maintenance of biological diversity from management area allocations.

Vegetation patterns across landscapes are the result of complex interactions between biotic and abiotic disturbances, processes, and constraints. Vegetation changes due to a variety of factors such as fires, insects, pathogens, human activity, animals, weather, growth, and competition. It can be difficult to project the combined effects of these complex interactions over long periods of time. Changes in vegetation structure over time for each alternative were predicted using growth and yield models. Succession models covering one to fifteen decades were formulated for each cover type for each alternative. Successional pathways were modeled based on forest conditions.

For each cover type, vegetation development followed a pathway based upon basic successional processes. Silvicultural treatments including timber harvest were used in the growth and yield model used to calculate the ASQ. Because of the stochastic nature of natural disturbance events, such as wildland fire, wind, insect and disease; they were not estimated, but rather discussed qualitatively in their respective sections. Other Vegetation Management (OVM) activities such as prescribed fire and mechanical treatment from unsuited lands were estimated as shown below, but have traditionally been at such a low level as not to change the successional direction of vegetation on a forestwide scale.

Table 3-58. Average annual other vegetation management acres estimated by alternative.

OVM Treatment	Alternative					
	A	B	C	D-DEIS	D-FEIS	E
Aspen	10	20	10	20	50	20
Forested Mechanical	100	400	100	400	300	600
Forested Prescribed Burning	500	1,100	250	1,050	1,150	250
Non-Forested Prescribed Burning	2,000	3,000	1,500	2,500	2,600	2,500
Total OVM Acres	2,610	4,520	1,860	3,970	4,100	3,370

As discussed fully in the Biological and Habitat Diversity section of this chapter, over the life of the Revised Plan there will be an increase in the amount of mature habitat structure stages 4c, and 5 for all alternatives, and a decrease in the early structural stages 1 and 2. Those alternatives with the greatest amount of timber harvest (E and A) show the greatest increase in habitat structural stage diversity, in the absence of natural disturbance processes.

Aspen Management

As shown in the table above, aspen will be treated to rejuvenate and regenerate aspen clones and attempt to expand the aspen cover type. Although new tools may allow us to accomplish more, the proposed levels in all alternative except D-FEIS are similar to existing program levels. Alternative D-FEIS heightened the emphasis on aspen treatment. Since there is limited aspen on the Forest, when it is regenerated, ungulate browsing can cause regeneration failures unless the clone is adequately protected from both domestic and wild ungulates. This added expense complicates the amount of regeneration the Forest can accomplish.

Habitat Structure Stages

Direct Effects

Changes in successional stages are set in motion by management actions and disturbances that create early seral vegetation, and continue on successional paths until actions or events alter them. This sequential development of forest stands and changes from early seral cover types to later successional cover types would occur over time following management actions or disturbances. A full discussion of affects of alternatives on habitat structural stages is found in the Biological Diversity section. However, as shown in the table below

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only a relatively few acres are projected to be creating early habitat structural stages (HSS). The forestwide differences in structural stage distribution between the alternatives is fairly small under all alternatives as only a small percentage of the Forest is projected for active successional change. Under all alternatives, natural processes will be the dominate force of successional change.

Table 3-59. Projected management actions to create early forested successional stages.

	Alternatives					
	A	B	C	D-DEIS	D-FEIS	E
Annual Clearcut harvest in acres						
Conifer	1,009	451	213	705	691	1,133
Aspen	10	20	10	20	50	20
Average Early HSS	4%	2%	2%	3%	3%	4%
Average Intermediate HSS	43%	44%	44%	43%	43%	43%
Average Late HSS	53%	54%	54%	54%	54%	53%

Indirect Effects

Habitat structure development indirectly affects other resources; for example, biological diversity, wildlife habitat, insect and disease, fire and fuels, and recreation. The effects are discussed in more detail in those individual sections:

Cumulative Effects

The cumulative effects table at the beginning of this chapter includes the list of past, present and reasonably foreseeable future activities that were considered with regard to cumulative effects to the insect and disease resource. The next 10 to 15 years are considered the time span for cumulative effects. For this cumulative effects analysis, the area considered is the Bighorn National Forest, plus about two miles past. This covers much of the transition between forest and prairie.

Lands adjacent to the Forest may have different objectives and be treated with different intensities. However, much of the operable land adjacent to the Forest that could be harvested, have been harvested. The anticipated harvest adjacent to the Forest is less than 50 acres a year of treatments around structures for fuel reduction, and some bark beetle and fire salvage operations. Given the overall size of the Forest, and the relatively small amounts of treatment under all alternatives, timber harvests from suited lands will only have a slight change in the age/size class and structural stage distribution of the Forest. Alternatives E and A project treating the most acres, while B and C treat the least, with D-DEIS, and D-FEIS in the middle.

The major agent of change to the forested lands will continue to be the growth and senescence, with disturbance events such as wildfire, wind, insects, and disease as the major source of deviation from that course.

Table 3-60. Estimated volume offered in Bighorn working circle per year for the next decade.

	Alternative					
	A	B	C	D-DEIS	D-FEIS	E
Bighorn National Forest ASQ Acres of Treatment	2,294	1,066	498	1,719	1,700	2,772
Anticipated treatment of adjacent lands	50	50	50	50	50	50
Total anticipated acres of treatment	2,344	1,116	548	1,769	1,750	2,822

Source: Woodstock © reports and personal conversations.

Rangeland Vegetation

General Effects

Livestock grazing managed through term grazing permits, along with the combination of vegetative treatment for rejuvenating aspen, maintaining native meadows, treating sagebrush and other shrublands to improve wildlife habitat and forage production, and fire treatment in ponderosa pine to replicate natural stands, will all help move rangelands vegetation toward desired conditions. Current trends in motorized recreational use, a lack of fire, and increases in noxious weeds, and livestock management outside of established standards and guidelines may move rangeland vegetation away from desired conditions.

Direct and Indirect Effects

Effects from Wilderness management: Suppression of wildfire in wilderness is limited to nonmotorized and mechanized means. Prescribed fire is not a management option in the Cloud Peak Wilderness. Vegetative communities are likely to move to late seral stages. This may have the effect of reducing the amount of earlier seral vegetation that would be expected under the Historic Range of Variability (HRV) and can affect plant and animal diversity.

Alternatives are identical in allocation of Management Areas 1.11 and 1.13. Alternative C has an addition of 126,575 acres of Recommended Wilderness, (MA 1.2). Alternative D-FEIS recommends 33,857 acres of Recommended Wilderness (MA 1.2).

Effects from Fire and Fuels Management: On rangelands, fire tends to alter the successional pathway, at least temporarily, and generally sets back succession to an earlier seral stage. It also tends to alter the structure of the vegetative communities. Wildfire, and more specifically high intensity wildfire, will often be a greater disturbance (more often move succession to an early seral stage and reduce or eliminate taller structure in sagebrush or other shrub communities) than will prescribed fire because planned/managed fires are often designed specifically to avoid drastic alterations on the landscape. Fire is a natural factor in the maintenance of natural diversity of vegetation across rangelands. It

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retards or prevents conifer or shrub encroachment in meadows and parks, regenerates aspen stands, and is responsible for maintaining a mosaic of vegetation necessary for wildlife habitat diversity. In general, the greater the use of prescribed fire, the greater the number of acres on which vegetative succession will be moved to an earlier seral stage and on which tall structure will be reduced.

Table 3-61. Non-forested acres treated using prescribed fire, by alternative.

	Alternatives					
	A	B	C	D-DEIS	D-FEIS	E
Non-Forested	2000	3000	1500	2500	2600	2500

The use of prescribed fire for fuels treatment and vegetative management is greatest in Alternative B and the least in Alternative C; however, differences among alternatives are not great, and implementation in all cases is subject to budget constraints and priorities.

Effects from Recreation Management: Recreation use generally has little effect upon rangeland vegetation except in the case of repeated or continual uses such as camping, fishing, and hiking, or especially off-road vehicle use. Repeated use by recreation horse or ATV use in popular areas can alter plant and soil characteristics over time. Such uses tend to return succession to an early seral stage, even to bare soil on trail systems and in very popular dispersed camping sites and along popular fishing areas, generally the number of acres impacted is a very small percentage of the total rangeland acres across the Forest.

Off-road Vehicle (ORV) activities that create bare or disturbed soil provide conditions for invasive species establishment and spread, including on roads and roadsides, trails, and trailheads, parking lots, developed and dispersed camping sites, popular fishing locations, and heavy-use areas around summer homes. Off-road vehicle travel has high potential to introduce and spread noxious weeds, and in turn move rangeland vegetation away from desired conditions.

Alternatives that emphasize summer recreation opportunities, especially motorized recreation may have a slightly greater effect on rangeland vegetation. The alternatives in terms of potential acres available to summer-motorized travel, from most to least, are E, A, D-DEIS, D-FEIS, B, and C. However, it should be pointed out that since the revised plan is prohibiting off-route motorized travel, the presence of motorized opportunities will now be dictated solely by whether or not a motorized system route is present.

Effects from Research Natural Area Management: Designations that reduce the amount of human-caused disturbances are likely to direct succession of the included rangelands toward late seral conditions (barring natural disturbance). RNAs are generally managed to promote natural succession and disturbance. Unless fire is allowed to play its role, some of these areas will progress to later seral communities and can lose the natural mosaic of seral stages that are necessary for rangeland health and the provision of a variety of wildlife and plant habitats.

Alternatives B, C, and D-DEIS have identical new RNA designations: Mann Creek, Leigh Creek, Pheasant Creek, and Lake McClain. Alternative D-FEIS recommends Mann Creek and Leigh Creek as new RNAs.

Effects from Travel Management: Effects are similar to those for recreation (described above) except they occur on a greater number of acres (roads versus trails). Past road construction has had the effect of contributing to a reduction of acres of native meadows and shrublands; roads constructed in and along valley bottoms have reduced and/or altered riparian vegetation and sometimes changed stream channel location and function. Roads tend to create a large impact on the health and sustainability of stream/riparian/wetland systems. Effects include lowered water tables, altered morphology, changed sediment regimes, and removal of canopy cover and other vegetation. Other uses may subsequently contribute to these effects. Currently, unauthorized off-road vehicle travel has had a great effect in moving rangeland vegetation to an earlier seral condition; this use is unplanned and can be widespread, with erosion and riparian degradation resulting.

Roads in the uplands tend to fragment rangeland vegetative stands, to alter hydrologic relationships by intercepting overland and sub-surface flow, and are potentially a significant contributor of seed and propagules for invasion of noxious weeds and other non-native vegetative species.

The alternatives in terms of potential acres available to summer-motorized travel, from most to least, are E, A, D-DEIS, D-FEIS, B, and C. However, it should be pointed out that since the revised plan is prohibiting off-route motorized travel, the presence of motorized opportunities will now be dictated solely by whether or not a motorized system route is present.

Effects from Oil, Gas, and Mineral Development: Effects are similar to those for Recreation (see above). The amount of rangeland vegetation that could move to an earlier seral stage is dependent upon the amount of exploration and resultant production. Production sites often create areas of disturbed soil, providing areas for noxious weed infestations. Restoration of these areas following production will involve monitoring and treatment of noxious weeds, along with re-establishment of native species. The potential for these activities is very small based upon past activity levels on the Bighorn National Forest. There is nothing in this analysis that indicates an increase in future levels of development.

Effects from Livestock Grazing and Big Game Use: Livestock, big game animals, and other wildlife that graze and browse the herbaceous and shrub cover on rangelands can be considered disturbance agents. These animals also create a disturbance through hoof action, which effects vegetation and soils in riparian and upland sites. Their effect depends on a number of factors including intensity, timing, and frequency of grazing, kind of herbivore, soil moisture and condition, and existing seral condition of the vegetation.

Use by ungulates, when properly managed by vegetative type and within habitat capacities, tends to provide for a mix of seral stages across broad landscapes. High intensity of use, repeated use during times of rapid plant growth, frequent use of individual plants or plant

communities, or longer periods of use tend to result in more vegetation developing into early-to-mid plant succession, while lighter, shorter, or less frequent use tends to result in a higher percentage of mid and late seral vegetation. High historic levels of grazing use across the Forest were very likely responsible for maintaining large acreages including riparian zones and wet meadows, in early to mid-seral condition.

Analysis indicates that 134,615 acres on the Bighorn National Forest are considered suitable for cattle and 185,235 acres are suitable for sheep. This coarse filter modeling exercise indicates that stocking is relatively heavy as compared to other forests in the USFS Rocky Mountain Region (see appendix B for details).

Reductions of grazing use over the last several decades coupled with increases in management intensity and improved knowledge regarding habitat requirements and plant ecology have likely resulted in increases in herbaceous production and trends toward the mid to later seral stages. Browsing and grazing of young aspen shoots can restrict aspen regeneration. These areas may need to be fenced, depending upon extent and location, or otherwise managed to control use by grazers and browsers until young trees are big enough to avoid being detrimentally browsed.

Big game populations are less manageable or predictable than domestic livestock, but their effects on managing for desired conditions are similar to those of domestic livestock. Elk tend to impact meadows and more open grasslands types, while deer impact shrublands, grasslands, and riparian areas, and moose impact riparian/wetland habitats. High numbers of big game species will result in maintenance of rangeland vegetation in an early or mid seral condition. Lower numbers allow more acres to move toward a later successional stage. In addition, seasonal use (such as big game moving up the mountain very early following green up each year) impacts plants when they are most vulnerable, sets back succession, and can damage wet soils. In the same way, seasonal and intense use on palatable shrubs such as mountain mahogany and antelope bitter brush can retard succession.

Currently, in some areas heavy utilization of willows by moose may be preventing riparian areas from achieving desired conditions. Moose browsing in some aspen stands has resulted in heavy “barking” of trees and hedging or elimination of young trees.

Grazing by permitted livestock and wild ungulates is not expected to differ significantly between alternatives.

Effects from Timber Management: There is no effect to existing rangeland vegetation from timber harvest. However, as timber is harvested it may open areas in the canopy so that an increase in forage occurs in the understory, or it may create new acreages of transitory (e.g. short term) rangeland vegetation in small harvest units. This transitory rangeland remains in this state until the forested stands once again close in or the young trees become dense enough that rangeland vegetation no longer occupies the site. In a dynamic forest, with some tree stands closing in while others are opening up, there is no net change in rangeland vegetation acres, except through large-scale natural disturbance events.

The order of alternatives with effects from timber harvesting activities, from least to most, is C, B, D-FEIS, D-DEIS, A and No Action, and E.

Cumulative Effects

The cumulative effects table at the beginning of this chapter includes the list of past, present, and reasonably foreseeable future activities that were considered with regard to cumulative effects to the rangeland vegetation. This discussion considers effects to rangeland vegetation from the early 1900s through the life of the plan on the Bighorn National Forest.

Historic use of the Forest continues to be evident in rangeland vegetation today. For example, some areas are continuing to recover from impacts of heavy grazing in the early 1900s. Riparian areas altered by tie hacking activities also continue to recover. Fire suppression activities in the past have resulted in conifer encroachment in areas, which in turn reduce total acres of rangeland vegetation, as well as forage production and availability.

There continue to be conflicts about allocation of forage resources between livestock and wildlife and the effects of their activities, considerations necessary due to wildfire and prescribed fire management, and recreation and timber harvest activities that result in bare soils and spread of noxious weeds.

Expectations are that the impact to rangeland vegetation from many uses on the Forest will increase as the population of local communities increases, baby-boomers retire, and as more people nationwide continue to seek places like the Bighorn National Forest to recreate. ATV use in particular has seen a dramatic increase recently that is expected to continue although the rate of growth is not likely to be as dramatic as it has been in the past decade (See Specialist Report for Recreation). Locally, the current boom in coalbed methane activity in the Powder River Basin has resulted in more demand for recreational use of the Forest, particularly for motorized uses, and this boom is expected to continue (BLM 2003). Use of prescribed fire will likely increase in coming years due to political influences effecting fuels reduction efforts nationwide. This may result in plant communities more similar to the HRV.

Management of rangeland vegetation to deal with cumulative effects will be consistent across all alternatives.

Wildlife

Introduction

The wildlife section focuses on effects to Management Indicator Species (MIS) and Demand species. These species serve several roles in forest planning, one of which is serving as surrogates for terrestrial wildlife species and their habitat in general. Riparian areas provide the most important habitat attribute for most wildlife, and are described in more detail in the Aquatics section of this chapter.

Threatened and Endangered species are addressed in the Biological Assessment (FEIS Appendix F), and Forest Service sensitive species are addressed in the Biological Evaluation (FEIS Appendix K), with effects to both groups of species summarized in the Biodiversity section of Chapter 3 in the Single Species Assessment. Effects to Species of Local Concern are also summarized there, with additional information contained in the Viability Process document (on file in the administrative record).

Legal and Administrative Framework

The **National Environmental Policy Act** (1969), as amended, requires the Forest Service to address fish and wildlife concerns during the environmental analysis process.

The **National Forest Management Act** (1976) requires the Forest Service to consider all resources in the land management planning process.

The Forest Service is directed by **36 CFR 219.9** to maintain habitat for viable populations of existing native and desired nonnative vertebrate species. Viable populations are defined as those with the estimated numbers and distribution of reproductive individuals to ensure their continued existence and that they are well-distributed. In order to ensure maintenance of viable populations, habitat must be provided to support at least a minimum number of reproductive individuals, and it must be distributed so that individual sub-populations can interact.

36 CFR 219.19 additionally directs the Forest Service to estimate the effects of changes to wildlife habitat; consult with biologists from other agencies; consider access and dispersal problems of hunting, fishing, and other uses; evaluate the effects of pest and fire management; and select management indicator species to be monitored (36 CFR 219(a)(1)).

The Wyoming Game and Fish Department (WGFD) is responsible for managing wildlife populations, while the Forest Service can directly affect population numbers, distribution, diversity, and species viability through the management of habitat. The Forest and the WGFD work in partnership to address habitat and population management issues for wildlife.

Resource Protection Measures

Terrestrial wildlife species on the Forest are very diverse in their habitat use and needs. Numerous standards and guidelines, primarily Forestwide, are included in all of the proposed alternatives to ensure that quality habitat for wildlife is maintained or enhanced.

Most management area prescriptions (MAs) provide general direction to protect or manage habitat, while others provide for a special emphasis on habitat requirements. MAs 3.5, 5.4, and 5.41 for example, provide management direction to benefit all species, and big game, respectively.

Forestwide direction for other resource management activities will accommodate many of the habitat requirements for most species, particularly riparian-dependent species. Livestock forage utilization guidelines are designed to result in maintaining or improving riparian and grassland habitats. Timber management direction directs adequate regeneration in harvested areas, and adequate snag and coarse woody debris amounts. Biodiversity guidelines direct retention of old growth habitat. Direction for other resource disciplines will benefit some wildlife species, including direction for caves, riparian resources, fire, and noxious weed management. The most significant changes for wildlife in this revision include increased protection for riparian, old growth, sensitive species, and elk security areas.

In addition to forestwide and management area direction, the Revised Plan sets a wide range of goals, objectives, and strategies for meeting the Forest's commitment to a sustainable natural resource base for the American people. Goal #1 is to ensure sustainable ecosystems; Objectives 1.a, 1.b, and 1.c contain strategies to benefit habitat for wildlife and ecosystem processes.

Direction for all alternatives identify many activities designed to improve the overall conditions on the Forest. These activities include restoring terrestrial habitat through such activities as prescribed burning or harvesting to regenerate aspen, sagebrush habitats, and decommissioning unneeded roads. Resource inventory and monitoring would also be included.

Abstract

The habitat of most species may be altered by management actions, but their population levels and distribution will likely remain close to existing conditions. The extent of habitat alteration is not anticipated to significantly influence carrying capacity for a majority of species. The primary effects to structural stages of wildlife habitat will continue to be from natural processes including wildfire, insects and disease, and blowdown, largely regardless of alternative, as described in the Biodiversity section of this chapter. Timber harvesting, as indicated by suited acres, would affect a maximum of up to 35% of the forested acres in Alternative E, with approximately 20% of the forested acres being affected by current and past harvests. Non-forested habitats would continue to be altered from wildfire, prescribed burning, and livestock grazing, at levels similar by alternative.

Elk security areas, used to model habitat for this MIS, would be at more risk in Alternatives E and A due primarily to increased road construction. Elk security areas would remain similar to existing levels in Alternatives B, and possibly increase in Alternative C if existing roads were closed in proposed wilderness in future project specific decisions. Elk security areas would be challenging to manage for in both Alternative D-DEIS and D-FEIS. Habitats for other MIS would remain largely similar to existing conditions at the forestwide scale for all alternatives. As lands adjacent to the Forest may continue to be developed, a higher value for the habitat resources on the Forest is predicted for wildlife species.

AFFECTED ENVIRONMENT

General

The Bighorn National Forest provides a wide diversity of habitats that support over 300 vertebrate species, and hundreds of invertebrate species. Wildlife species interact in many ways with their environment as key components of ecosystem processes. These species provide Forest users and visitors with a full range of opportunities that include sport, commercial, and viewing activities.

Historical records reveal that some species on the Forest were extirpated in the early 1900s. Examples are the grizzly bear, gray wolf, and otter. Animals with diminished populations include lynx (if they still occur at all), bighorn sheep, and beaver. Introduced species (desirable non-natives) include moose, wild turkey, chukar, and gray partridge. Other introduced predators such as feral cats and dogs may also have an affect on wildlife. Wolves may re-establish on the Bighorn National Forest, as recent sightings have occurred, though depredation measures have taken place and may also inhibit establishment of wolf packs as acknowledged in the State's management plan.

Big game numbers and management on the Forest mirrors what occurred over much of the western United States during the last 50 years of the 20th century. Big game numbers throughout the West increased dramatically before World War II from the low numbers at the turn of the century. Regulated harvest, game preserves, winter feeding programs, and re-introductions were the management focus. On the Forest, as over much of the West, an era of biological game management followed. Scientific research increased dramatically, and hunting was adopted as the primary management tool to manage game populations. Habitat management also became a large focus. As of 2004, elk populations are at, or exceed, WGFD objectives over much of the Forest, while mule deer are at or below objectives.

Habitat, in terms of composition of covertypes and structural stages, was described in the Biodiversity section of Chapter 3. Terrestrial biodiversity on the Forest is especially high in riparian, aspen, and spruce-fir habitats. Other unique communities include the alpine meadows, cliffs and rock, and caves. The more abundant or common covertypes of lodgepole pine, meadows, and shrublands are also important for wildlife, though are less unique to the

Big Horn Mountains ecosection and are viewed to be less limiting factors in wildlife abundance and distribution as compared to the other communities.

Several aspects of habitat importance to wildlife have already been described in the Biodiversity section of this chapter, including composition, structure (habitat structural stages), snags and coarse woody debris (CWD), and fragmentation. Other sections including the Aquatic, Rangeland Vegetation, and Forested Vegetation also describe elements of importance to wildlife and their habitat.

The largest change in terrestrial habitat conditions on the Forest from pre-settlement times has been the development of a road network and associated facilities. This involves a direct loss of habitat and disturbance to some wildlife species, and opportunities for expansion of noxious weeds or other non-native plant and animal species. However, roads also provide the primary method of access for people to enjoy wildlife and other associated values of the Forest. Of more minor effects to habitat have been fire suppression efforts in some covertypes (ponderosa pine and sage brush), and the introduction of non-native species such as the white pine blister rust and noxious weeds. Emerging habitat and species issues include the decline or effects to amphibians and invertebrate pollinators, and balancing the amount of human use versus potential disturbance to species and their habitat.

Cumulative effects in general are presented at the scale of the Bighorn National Forest and those lands immediately adjacent to it, or in some cases the Big Horn Mountains ecosection.

Current program emphasis focuses on improving habitat through treatments including prescribed burns, aspen enhancement, and riparian improvements primarily through changes in livestock grazing. Other projects including structural improvements such as nest boxes and inventory for rare species also occur. Biologists on the Forest are actively involved in support and analysis of other resource programs including timber, recreation, livestock grazing, and noxious weed treatment.

Emphasis Species

Emphasis species were identified to facilitate analysis and monitoring of effects to wildlife. They include Threatened, Endangered, Forest Service sensitive, Management Indicator Species (MIS), and Species of Local Concern. Excepting MIS, these categories represent species whose populations either are in peril or could be in peril and therefore demand increased management attention. MIS, on the other hand, serve several functions in forest planning as documented in the MIS Selection Process document in the administrative record. The Emphasis Species Categories document (on file in the administrative record) describes the selection process for these species. As mentioned previously, the Single Species Assessment in the Biodiversity section of this chapter describes the effects to TES and Species of Local Concern. The Ecosystem Assessment portion of the Biodiversity section describes the condition and effects to habitat in general on the Forest for purposes of assessing viability for wildlife. The main approach for species viability is to ensure that ecosystem components and processes remain functioning, and then verifying needed habitat components persist for rare species and species representative of others due to similar habitats.

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While Management Indicator Species (MIS) are required for use in management plans as described below, the use of Demand species is a new addition to the planning process, and is optional. Demand species are identified for their social importance, usually relating to the commercial or sport value (e.g., hunting, fishing, collecting) of the species. In conjunction with the WGFD, the Forest identified 10 terrestrial wildlife Demand species, including **mule deer, moose, mountain lion, black bear, wild turkey, ruffed grouse, blue grouse, sharp-tailed grouse, chukar, and gray partridge**. Their existing condition and associated effects from alternatives are described below.

MIS are required (36 CFR 219.19) for forest plan analysis and monitoring purposes. MIS are selected to represent management issues and their effects to wildlife species. MIS serve multiple functions in forest planning: focusing management direction developed in the alternatives, providing a means to analyze effects on biological diversity, and serving as a reliable feedback mechanism during forest plan implementation. MIS can act as a surrogate for analyzing and monitoring all wildlife species. In addition to providing a comparison among alternatives in the Revised Plan, monitoring of habitats is meant to provide an indication of the level of effects of management activities on wildlife. During plan implementation, MIS are used in project level analysis to assess effects to wildlife. Several categories of species are to be considered when selecting MIS, though there is no requirement to have a MIS for each habitat type, species group (e.g., TES), or management issue. The requirement in the 1982 regulations to monitor population trends was modified with the publication of the 2005 planning regulations. The 2005 regulations clarify the role of habitat monitoring and suggest that population information, where available, would be used in addition to habitat monitoring information. Monitoring is a challenge with significant costs, and many factors other than regular management activities (e.g., prescribed fire, timber harvest, livestock grazing, recreation use) can affect populations of MIS, with climate and prey/forage levels being the most common elements driving population trends.

The Bighorn National Forest considered over 100 species when selecting MIS for the Revised Plan. Six species were selected: **elk, rainbow trout, beaver, red-breasted nuthatch, red squirrel, and Brewer's sparrow**. The only species of viability concern selected as an MIS is the Brewer's sparrow. Refer to Appendix C in the Revised Plan for a summary of the selection process, results, and management implications with regard to MIS. In addition, the MIS Selection Process document (on file in the administrative record) lists details of the selection process, and Chapter 4 of the Revised Plan contains monitoring aspects of MIS. Species assessments (on file in the administrative record) for MIS assess current habitat and population trends, and conservation measures. A summary for the species' habitat, indicator representation, and rationale for selection of each species is listed in the table below.

Table 3-62. MIS selected for the Bighorn National Forest.

Species	Habitat Association	Indicator	Rationale for Selection
Elk	Forested stands (cover), and grasslands/shrub (foraging)	Security Areas (Acres)	Elk are of high social and past management importance and are sensitive to road densities and forested vegetation alterations. Local research supports understanding of habitat associations, and characteristics of security habitat. Elk association with security habitat can represent needs of other species where larger blocks of cover away from roads is needed. Management activities such as timber harvest, motorized recreation, road construction or decommissioning, and prescribed burning are issues for this habitat/species. Monitoring of habitat is feasible through remote sensing (vegetation and road GIS layers). Population monitoring is provided by WGFD.
Beaver	Riparian	Occupied Watersheds	Beaver were selected for their ecological role as environmental engineers in riparian habitats. Riparian areas are ecologically important on the Forest and strongly influenced by management. Beaver activity changes hydrologic functioning and significantly influences both vegetation and animal communities. Beaver numbers are reduced compared to historic abundance. Management activities in riparian areas including livestock grazing, dispersed recreation, and road reconstruction, construction, and maintenance are issues for this habitat/species. Monitoring of habitat occupancy and population trends is feasible through aerial/ground surveys.
Red-breasted nuthatch	Mature Conifer, Snags	Mature Structural Stages, Snag abundance	Red-breasted nuthatches are a resident avian species using snags for nesting habitat. Management activities including timber harvest and prescribed burning may change habitat for this species. Their widespread distribution on the Forest and vocal detectability will facilitate monitoring through avian point counts. Habitat monitoring is feasible through remote sensing (vegetation GIS layers).

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Species	Habitat Association	Indicator	Rationale for Selection
Red squirrel	Mature conifer, Coarse Woody Debris	Mature Structural Stages, Coarse Woody Debris abundance	Red squirrels are resident mammals occurring forestwide. Though somewhat habitat generalists in conifer, they are most abundant in mature habitat with CWD, and respond to changes in that habitat. They are a primary prey species, and serve as a “keystone” as a result of midden construction. Management activities including timber harvest and prescribed burning change habitat for this species. Habitat monitoring is achievable through remote sensing (vegetation GIS layers). Their vocal detectability will facilitate monitoring through associated avian point counts.
Brewer’s sparrow	Sagebrush	Shrub age class diversity	Brewer’s sparrows, though migratory, are strongly associated with sagebrush, in typically mature age classes. They have a forestwide distribution in appropriate habitat, are a sensitive species, and are detectable through avian point counts for monitoring. The Forest has sought to actively manage sagebrush habitats to restore habitat diversity currently lacking, and this species would provide an indicator for this issue and habitat type. Habitat monitoring is achievable through remote sensing (vegetation GIS/aerial photo layers).
Rainbow trout	Aquatic	Riparian habitat quality	Rainbow trout, an introduced species, are associated with quality riparian habitats and respond to changes in the habitat. Populations occur forestwide. Management activities including livestock grazing, dispersed recreation, and road construction, maintenance, and decommission are issues for this species/habitat. Population and habitat monitoring currently occurs in conjunction with the WGFD, and allotment administration.

The habitat conditions for, and effects to, rainbow trout are described in the Aquatics section of this chapter.

The following affected environment and environmental consequences sections describe effects to the MIS and Demand species listed above. MIS species sections occur first, followed by reviews for demand species. Not all management activities are assessed in the environmental consequences, as only those deemed to be most significant were described.

Management Indicator Species (MIS)

AFFECTED ENVIRONMENT ELK SECURITY HABITAT

Elk were greatly reduced in abundance on the Forest in the late 1800s due to unregulated hunting. Elk were transplanted back onto the Forest beginning in 1910 to reestablish huntable populations. Elk have been the subject of management emphasis and concern since that time, largely due to public interest in hunting and viewing. The 1985 Plan contained management direction (i.e. hiding cover amounts and habitat capability) specific to ensuring habitat for this species, as it was a selected MIS. Timber harvest was the primary management concern. Harvest units on the Forest were laid out in the 1960s and 1970s as larger clearcuts to efficiently produce wood products. A byproduct was forage for big game species including elk. The trend in harvest sizes switched to smaller patch cuts in the 1980s and 1990s in response to public concern, and as a result higher levels of big game cover were maintained than previous methods, but with forage still generated. Forage quantity, however, has not been identified as a limiting factor in big game populations on the Forest, due to the natural distribution of meadows and shrublands on the Forest. These actions were based on the recommended practices at the time.

Beginning in 1991, the Forest and the WGFD began to address habitat concerns associated with roads and timber harvest and sought to improve management direction in the ASQ amendment (1994), which was never completed. Specifically, it was recognized that hiding cover, which is defined as cover that will hide 90% of an adult elk at 200' (Lyon and Christensen 1992), did not incorporate the larger concern of the effect of road densities on elk distribution. Through telemetry research conducted in 1993 - 1996, it was demonstrated that elk began selecting more remote locations (away from roads) beginning in July, when human use of the Forest increases (Sawyer 1997, WGFD 2004). Both an elk habitat effectiveness model and an elk security habitat model were generated by the WGFD in response to this research to better coordinate management activities with the Forest. These models produced different values than the elk habitat effectiveness model that was used in the ASQ amendment, as developed in 1991 by the interagency wildlife task force. As both the Forest and the WGFD desired to only use one model to assess effects to elk at both the programmatic and project scales of analysis, the elk security model was selected for this plan revision and adopted by the Forest. This also alleviates the "non-spatial" aspect that can be associated with using habitat effectiveness rather than the more spatially explicit elk security model (Rowland et al 2000). All of these actions are typical of recommendations in recent literature (Christensen et al. 1993).

Elk security habitat is defined as "any area that will hold elk during periods of stress because of geography, topography, vegetation, or a combination of those features" (Lyon and Christensen 1992). Hillis et al. (1991) quantified elk security areas as nonlinear blocks of

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hiding cover \geq 250 acres in size and \geq one-half mile from any open road. They noted that elk vulnerability increases when less than 30% of an analysis unit is comprised of security areas.

For planning purposes, the nine geographic areas (5th-level watersheds) described in the Revised Plan (Ch. 3) were selected as the analysis units. The potential and existing amounts of security habitat were assessed by the Forest in these areas. Existing security areas were defined as those areas that met the habitat criteria (forested structural stages 3B,C and 4B,C with 60% canopy cover, \geq 250 acres, $>1,200'$ wide) that were greater than one-half mile from any open road (Level 2 – 5) or motorized trail. Potential elk security areas were also assessed to delineate areas that could meet existing security if road closures were conducted on Level 2 roads or motorized trails. For potential security, the same habitat parameters were used, although it was assumed that the Forest would never likely close a road if it were a Level 3 – 5 due to investments (gravel, etc.), so areas within a $\frac{1}{2}$ -mile buffer of these types of roads could not be considered potential. Sites that may grow into suitable cover within the next decade or two (e.g., the Lost Fire of 1988) were not considered in potential security areas. Existing and potential security areas were based on current habitat structural stages (2002 CVU data). The biological potential of the Forest to provide security areas, in other words without any roads, was not assessed due to the unrealistic ability to change densities of the higher maintenance level roads (3 – 5). Refer to the map in Appendix A of the Revised Plan to view the location of existing and potential elk security. The following table displays the amount of existing and potential elk security in each of the nine geographic areas.

Table 3-63. Elk security habitat areas by geographic area on the Bighorn National Forest.

Geographic Area	Total Acres in Planning Unit*	Percent Forested	Existing Security Habitat Acres and Percent of Total Area	Potential Security Habitat Acres and Percent of Total Area	Existing Security as a Percent of Potential Security Habitat
Clear/Crazy	155,936	72%	9,506 (6%)	29,735 (19%)	32%
Devil Canyon	61,198	58%	5,685 (9%)	12,748 (21%)	45%
Goose Creek	116,952	80%	18,786 (16%)	43,053 (37%)	44%
Little Bighorn	141,815	69%	22,551 (16%)	33,855 (24%)	67%
Paintrock Creek	107,943	51%	5,992 (6%)	10,227 (9%)	59%
Piney/Rock	110,255	79%	30,988 (28%)	64,197 (58%)	48%
Shell Creek	140,130	48%	4,690 (3%)	14,780 (11%)	32%

Geographic Area	Total Acres in Planning Unit*	Percent Forested	Existing Security Habitat Acres and Percent of Total Area	Potential Security Habitat Acres and Percent of Total Area	Existing Security as a Percent of Potential Security Habitat
Tensleep Creek	101,130	57%	647 (1%)	7,678 (8%)	8%
Tongue River	177,069	69%	26,976 (15%)	51,411 (29%)	52%
Totals			125,821	267,684	
	1,112,428	~60%	(11%)	(24%)	47%

* = All National Forest lands within planning unit.

As described above, elk were selected as a MIS due to the social interest in the species, and due to the species' habitat associations with forested canopy cover alterations and road densities. Security areas provide an analysis function for species with similar habitat associations, namely larger blocks of forested stands that have less human disturbance as they are greater than one half mile from an open road. Examples of other emphasis species that may benefit from this type of habitat include American marten, lynx, wolverine, goshawk, boreal owl, flammulated owl, great gray owl, pygmy nuthatch, golden-crowned kinglet, and black bear. As displayed above, some geographic areas do not have the potential for enough security to meet the recommended level of 30% per analysis unit, largely due to a lack of forested cover from naturally occurring meadows and shrublands. Many geographic areas are also well below the potential they could have due to Level 2 roads and motorized trails. Hillis et al. (1991) did not specify a minimum threshold of elk security for maintaining population abundance or to meet other specific management objectives. However the Interdisciplinary Team (ID Team) recognized the need to maintain at least the existing amount of elk security (47% of potential) and seek to improve it where possible in plan implementation activities, as described in the Revised Plan strategy (See Objective 1b, Strategy #6 in Ch. 1 of the Revised Plan).

Aside from the association with fragmented forested habitat and road densities, the second issue surrounding elk security areas is the desire to be able to achieve hunter harvest on public lands. Currently, elk begin moving to secure areas on the Forest starting in July, with an increasing rate as hunting seasons begin. During hunting seasons, elk routinely leave the Forest to seek even more secure areas such as private lands where hunting is not allowed, resulting in a difficult situation with regard to maintaining herd objectives as harvest does not occur. It is not certain that improving security areas on the Forest will reverse this trend, as annual movements to private lands in autumn has become common in most of the elk herds, however improvements in security habitat on Forest lands may reverse this trend. Elk security is not intended to increase populations of elk, as most herds are at or above objective. The intent is to encourage elk to stay longer on public lands, where harvest objectives may be more easily met.

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The following table displays the herd objectives and current populations for the herd units for which a portion of the habitat occurs on the Forest. Population objectives are developed at the herd unit scale. Hunter success in the hunt areas on the Forest, which are subsets of herd units, is listed, along with the hunting season type. Limited hunts involve a hunter applying for a limited number of licenses, versus being able to obtain a permit “over the counter” for a general hunting season. All data is from the WGFD (2003).

Table 3-64. Elk herd objectives, populations, and hunter success by herd unit and hunt area as of 2003.

Herd Unit/Hunt Area	Population Objective	Current Population	Hunt Strategy	Hunter Success
<i>North Bighorn HU</i>	4,100	4,800		
HA 35			Limited	39%
HA 36			General/Limited	17%
HA 37			General/Limited	19%
HA 38			Limited	29%
HA 39			Limited	36%
HA 40			Limited	30%
<i>Medicine Lodge HU</i>	3,000	3,000		
HA 41			Limited	19%
HA 42			Limited	17%
HA 45			Limited	41%
HA 46			Limited	33%
<i>South Bighorn HU*</i>	2,900			
HA 34		1,200	Limited	35%

* = Only a small portion of the herd unit occurs on the SE portion of the Forest.

Elk security cover indirectly improves local economies because of the hunter opportunity generated by the quality habitat and resulting hunting experience. This becomes evident where general hunting season areas have been switched to limited entry, reducing both the number of hunters in the field and hunter success (WGFD 2004). The change in number of hunters has been especially evident in Hunt Area 35, near Buffalo.

Reductions in road densities to improve elk security cover need to be balanced with the public’s desire to have motorized access for hunting and other recreation pursuits, including wildlife viewing, fishing, and scenic viewing. Adequate access is also necessary to achieve desired elk harvest levels. Closed roads and non-motorized trails are also main avenues of recreation access, providing larger disturbance potentials to wildlife from recreation as compared to areas where no trails or roads occur. While changes in road density can improve elk security cover through seasonal closures during hunting seasons, the benefit of year-round secure habitat for other species is also important. The main challenge to this type of habitat

has been from the increased use of ATVs as compared to conditions projected in the 1985 Plan. Snowmobiles may also reduce the winter availability of secure areas, mainly for species other than elk.

Currently, no specific elk habitat monitoring occurs on the Forest, other than verification of application of standards and guidelines in projects. The 1985 plan directed habitat monitoring and treatment for big game winter ranges, which has not regularly occurred, though some project specific treatments (e.g., prescribed burns) have occurred with monitoring for that purpose. The Forest provides little winter range, and is primarily used by elk in the spring through the fall. Issues with winter range primarily focus on human disturbance and stress, for which the 1985 plan contained management direction, as would the revised plan. Refer to the section on mule deer for more discussion on this topic.

Economics and recreation (hunter day) factors surrounding elk hunting on the Forest are listed in the respective sections of this chapter.

It is the desire of the Forest to coordinate with the WGFD to improve security habitat on the Forest, to improve the ability to maintain elk herds within population objective and to provide improved hunter opportunity. Elk were not selected as an MIS due to concern with the viability of elk populations, however.

ENVIRONMENTAL CONSEQUENCES

ELK SECURITY HABITAT

Direct and Indirect Effects

Existing elk security areas were incorporated into several different management prescriptions by alternative. For example, in Alternative B, most of the elk security areas were included in Management Area 3.5. Where elk security occurs in Management Area (MA) 5.11, 5.12, 5.13, 5.4, and 5.5, it is more difficult to retain due to multiple use objectives in those areas. The opposite would be true for management prescriptions in Categories 1 and 2. The following table displays the acres of existing elk security by management prescription, by alternative. Following are additional tables with more management activity related effects.

Table 3-65. Acres of existing elk security areas by management prescription and alternative.

Management Prescription	Alt A (Acres)	Alt B (Acres)	Alt C (Acres)	Alt D-DEIS (Acres)	Alt D-FEIS (Acres)	Alt E (Acres)
1.11	5,286	5,286	5,286	5,286	5,286	5,286
1.13	3,911	3,911	3,911	3,911	3,911	3,911
1.2	0	0	47,595	0	19,104	0
1.31	0	14,554	0	11,325	2,575	262

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Management Prescription	Alt A (Acres)	Alt B (Acres)	Alt C (Acres)	Alt D-DEIS (Acres)	Alt D-FEIS (Acres)	Alt E (Acres)
1.32	20,820	3,554	9,480	12,028	11,991	5,828
1.33	1,640	2,634	2,118	206	31	1,223
1.5	2,218	3,116	3,300	2,169	2,822	2,218
2.1		887				
2.2	524	8,654	8,654	8,654	1,408	524
3.1		2,338	2,338	2,338		2,338
3.31	1,341	4,639	16,663	13,299	9,875	171
3.4	365	322	138	0	16	
3.5	17,867	51,336	9,949	28,632	26,669	
4.2	159	1,267	1,267	1,485	754	104
4.3		3,007	8,531	691	378	244
4.4		217	217	0		
5.11	23,361	8,114	4,775	16,640	6,865	26,027
5.12	9,749	3,530	715	6,929	3,647	780
5.13	33,379	7,573		11,011	15,060	11,251
5.21	640					
5.4					8,410	50,299
5.5					3,544	11,987
5.41	4,099	417	420	754	675	2,906
MW					2,338	
Total	125,358	125,358	125,358	125,358	125,358	125,358

Effects from Timber Harvest and Travel Management: In addition to management prescription analysis, the likelihood of road construction or timber harvest in elk security areas was also assessed by alternative. Timber harvests are conducted to accomplish other resource objectives in addition to providing commercial products. There are benefits from harvest activities in terms of forage production for elk and other wildlife, and general habitat diversity in terms of a variety of age classes created (structural stages). Timber harvests also remove a cover component of elk security habitat, and frequently roads are constructed to access timber stands, which are the two main variables in assessing elk security areas.

Alternatives B and C would likely retain existing elk security areas in their current configuration for the next planning period. Small areas of existing elk security would likely be entered in both Alternative D-DEIS and D-FEIS. Larger areas of existing elk security

would be entered in Alternatives A and E. This is indicated by the amount of acres suited for timber production by alternative within elk security areas. The overlap of suited acres with security areas does not mean that harvest or road construction would necessarily occur. However, the likelihood of harvest and road construction activities increase with the number of acres of overlap given the higher objectives for timber harvest associated with those acres. The following table displays the acres of suitable timber within existing elk security by alternative.

Table 3-66. Approximate acres of suited timber within elk security habitat.

Alternative	Suited Acres in Existing Elk Security	Suited Acres in Potential Elk Security
E	63,086	136,431
A	51,594	114,515
D-FEIS	25,072	66,023
D-DEIS	22,756	58,886
B	14,247	37,299
C	4,589	13,552

An additional analysis would be to examine the number of acres predicted for harvest within elk security habitats by the timber model. The following table displays the results of acres predicted for harvest within elk security habitat.

Table 3-67. Acres of predicted timber harvest within elk security habitat by alternative during 1st decade (planning period).

Alternative	Acres Predicted for Harvest in Existing Elk Security
E	2,774
A	1,181
D-FEIS	1,181
D-DEIS	794
C	756
B	643

As displayed in the tables above, Alternative C would have the least potential effect on elk security, whereas Alternative E would have the most. Within this range, Alternatives B, D-DEIS, D-FEIS, and A would have impacts to elk security, in order of least to greater potential impacts. It should also be noted that acres of predicted harvest within elk security areas may or may not result in a loss of security areas, depending on the road network needed to access an area harvested, and associated mitigation applied (closure of adjacent areas/routes). Specifically, the areas including Piney and Rock Creek and areas bordering Walker Prairie

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would be roaded under Alternatives A and E, with the Piney/Rock Creek main access road likely being left open to motorized vehicles.

While elk security areas can theoretically be maintained by closing roads following uneven-aged harvest prescriptions, the risk of losing the integrity of the security area increases as more acres are harvested and more roads are built. People will continue to use roads and skid trails for access, whether by foot or horseback, depending upon the closure effectiveness. Studies on other Forests have indicated a significant problem in achieving effective closures (Griffin 2004), and the Bighorn faces similar challenges. Road impacts can be offset by management of access prior to initiating timber harvest. Road closure in areas adjacent to planned harvest units can improve elk security prior to entering the adjacent area. In addition, if timber harvest were to treat larger areas (greater than 40-acre clearcuts), similar to natural disturbance processes in lodgepole pine, fewer roads would be needed, resulting in less impact on elk security.

It is also important to note that the elk security areas can also be used to serve as reserves to meet the old growth biodiversity guideline. It is beneficial to manage for these acres within elk security areas for other species benefits, and this was an approach used in the modeling process for timber harvest.

It is also likely that some improvements to elk security would occur with Revised Plan implementation. In recent timber sales on the Forest, more miles of existing roads have been closed as compared to miles of new roads built. In addition, the Forest will likely be decommissioning or realigning approximately 4 miles of road per year in the next planning period, regardless of alternative, resulting in the potential to improve elk security habitat. However, there may also be additional user-created trails and roads from motorized vehicles that may reduce the effectiveness of what has been identified as existing elk security, or potential elk security. It should be noted that user-created roads are not included in the model since they are not Forest Service system roads, and often locations are not specifically known.

It is assumed that by entering any existing elk security areas that security areas would be created within the geographic area through road closures to mitigate any additional created roads. However, this has yet to be tested at the project implementation scale, given known public resistance to road closures. It is feasible to rotate elk security areas on the landscape. In other words, as harvest or other vegetation management is conducted in one area, an adjacent area could have roads successfully closed to allow for elk and other species to use those areas. Similarly, as forested areas are either harvested or grow up, the forested cover aspect of security habitat can be rotated on the landscape. Travel management decisions would need to incorporate considerations for elk security, as would other vegetation management (e.g., prescribed fire) projects. The current projections for prescribed fire that have the potential for reducing forested canopy were described in the Fire and Fuels section of this chapter and are relatively minor acres of forested habitat (approximately 500 acres per year).

Timber harvest and other vegetation management projects are also important for elk and other animals that rely on early seral stages for forage or other habitat needs. It is not desirable to retain mature forested canopies over the entire Forest to keep security areas, but rather a

balanced need for a diversity of structural stages also needs considered (Toweill and Thomas 2002). The creation of additional forage in Alternatives E and A would benefit summer range conditions, though the availability of the forage may be offset if roads are not effectively closed and elk do not use the areas. Also, summer forage quantity has not been a limiting factor for elk due to the natural interspersed of meadows on the landscape. It was this need for recognizing some treatment, and the likelihood of wildfires or prescribed burns that resulted in crafting the final guideline that allows for natural disturbances to occur, but provides guidance for managers to retain elk security when conducting planned management activities. The Forest intends to manage towards maintaining the 47% of potential that currently exists.

One final consideration with elk security that would be addressed at the site-specific level is the association of cover and slope. In general, as indicated by soil classification inventories and profiles (on file in the administrative record), the most valuable wildlife habitat occurs on more gentle slopes, as soils are more productive in these sites, offering greater vegetative diversity and structure regardless of vegetation type. It is noted that many activities (livestock grazing, timber harvest, road construction) also occur within these zones, and this would need accounted for to allow for better distribution of elk security habitat at the site-specific project scale if needed.

Effects from Livestock Grazing: Livestock grazing would have no direct effects on elk security habitat. However, security habitat is most effective when it occurs adjacent to quality foraging habitat. Livestock grazing will remove forage that would be available to elk and other wildlife. Forage utilization standards and guidelines were developed with this in mind, and administration of these measures would largely address this issue. Currently, primarily only localized areas within individual allotments have problems with the cumulative use of rangeland vegetation by livestock and wildlife. There is no difference by alternative with these effects.

Effects from Recreation Management and Special Uses: Recreation activities will influence the effectiveness of elk security cover. In the absence of other large predators, human disturbance is the only major factor that displaces elk. The potential affect of humans is addressed in the discussion above on travel management. Where higher road densities occur, there is greater viewing and hunting pressure on elk, providing the disturbance that causes elk to seek secure habitat. Studies have shown that hunters, and presumably most recreationists, stay within ¼ mile of open roads and trails (Lyon and Burcham 1998). Disturbance is largely a function of dispersed recreation use, as developed campgrounds are a localized source of disturbance. A surrogate for dispersed recreation would be the motorized recreation opportunities on the Forest, which largely follow trends in road development associated with timber harvest as described above, with similar effects by alternative.

With regard to effects on winter range, disturbance from recreation is typically of concern, as stress during this period can increase mortality. Most of the activity on winter range involves collection of antler sheds. Similar to the 1985 Plan, areas of identified winter range were mapped by the WGFD and would be closed to motor vehicle traffic on Level 2 roads as prescribed by the forestwide guideline. There have been few vegetation management projects

in winter range to improve forage conditions in the past several years, with the exception of the west side of the Forest. There would likely be no differences among alternatives with regard to disturbances or treatments on big game winter range.

Special use activities such as recreation cabins, lodges, and other uses displace some wildlife, though these activities are not currently thought to be as significant as dispersed recreation.

Cumulative Effects

In general, cumulative effects are assessed for the Forest and the adjacent lands within three miles of the Forest boundary. The period considered for this analysis is the anticipated life of the plan, 10-15 years. Cumulative effects include the past, present and reasonably foreseeable future actions, as mentioned in the summary of activities table in the introduction to this chapter. From this table, for elk, the past and present activities of vegetation management and roads are the most significant, and the reasonably foreseeable future activities of subdivisions and increased recreation use (OHV, demographics) are most significant.

As described in the Biodiversity section, it is likely that wildfire will continue to influence the majority of cover and forage attribute conditions of elk security regardless of alternative. It has been the increased road densities and recreation use that has led to the current lack of elk security. While some areas are less than the recommended 30% by geographic area due to these activities, some areas are naturally lower than 30% due to the amount of meadows vs. forested areas. The Forest has also begun to address this in recent timber harvest and travel management decisions, seeking lower overall road densities.

The likely increase in recreation use due to population factors surrounding the Bighorns, regardless of alternative, will continue to increase on the Forest and challenge us in managing the creation of additional roads and trails, and in the additional disturbance to wildlife. The Forest provides the majority of summer habitat in the cumulative effects area, with winter range occurring primarily off of the Forest.

On lands adjacent to the Forest within three miles of the Forest boundary, private land is often viewed as refuges, as many landowners currently restrict hunter access either by charging high fees or through simple denial. Elk use of these areas is often highest during the late summer and fall disturbance periods. The WGFD continues to work with landowners on this issue to gain access to achieve a better elk harvest. It is not known if improvements in elk security habitat on the Forest would alter or reverse the migratory behavior of elk to these areas during periods of stress, though it is possible over time (Thompson and Henderson 1998). This 'private refuge' issue is important to the WGFD's management of elk, as it makes it more difficult to stay at population objectives, especially when winters are mild and forage is sufficient to support large populations.

It is also known that elk from the North Bighorn herd unit winter in Montana on the Crow Indian Reservation. Both harvest and disturbances occur on this area, though effects are not well known. Finally, the development of timber resources on private land adjacent to the Forest, primarily in the southeast corner, also occurs, creating some roads and removing some

cover aspects of elk security habitat. The additional roads and loss of cover is somewhat mitigated by restricted access on private lands, and the effects of this use are fairly localized.

Losses of elk security areas would presumably lower the habitat available for the other wildlife species associated with this type of habitat.

It is not likely that the changes to elk security from the alternatives would have a measurable effect on elk populations in the next planning period. Elk populations respond more to changes in climate (e.g., drought), which influences availability and quality of forage in summer and winter. Loss of winter range is another issue for elk populations. However, under most climate conditions, hunter harvest is the most important factor influencing population abundance. Harvest can be directly affected by the location and extent of elk security areas on the Forest. If improvements in elk security occur, it is likely that the WGFD would be able to better manage elk populations with regard to objectives due to the increased effectiveness of hunter harvest. The Forest would likely try additional seasonal road closures to improve security habitat in areas. For economic relevance of hunter harvest, refer to the social section in this chapter. The following table illustrates the cumulative effects from the alternatives considered.

Table 3-68. Relative impact of alternatives on elk security.

Land Use Category	Less Impact ← Relative Impact → More Impact to elk security habitat					
Effects from land authorizations	No difference between alternatives					
Effects from motorized recreation mgmt. (potential for user created roads and increased dispersed recreation use associated with anticipated road construction)	C	D-FEIS	B	D-DEIS	A	E
Effects from livestock grazing	No difference between alternatives					
Effects from timber harvesting (tie to suited acres and potential loss of cover)	C	B	D-DEIS	D-FEIS	A	E
Effects from utility corridors and additional development of land	No difference between alternatives					
Land available for locatable minerals and oil and gas	C	B	D-DEIS	D-FEIS	A	E

Refer to Revised Plan Ch. 4 (Monitoring and Evaluation) for details on how this habitat attribute would be monitored through plan implementation.

AFFECTED ENVIRONMENT

BEAVER HABITAT

Beaver are native and widespread throughout Wyoming. They are currently not well distributed and populations on the Forest are substantially reduced from historical levels. Heavy trapping of beaver occurred throughout Wyoming in the late 1800s and early 1900s, followed by active reintroduction programs through the 1930s and 1940s (Blair 1987). This same trend was evident on the Forest (USDA 1914-1941). While not at risk from a viability perspective, improvements in distribution on the Forest are warranted, as beaver have long been recognized as ecological engineers responsible for raising water tables and stabilizing riparian ecosystems (Olson and Hubert 1994). Current observations and past detection flights (WGFD 1995) indicate their decline throughout the Forest.

On the Bighorn National Forest, beaver occupy primarily willow-dominated riparian systems and may use willow, aspen, and conifer trees in dam building. Beavers are also a disturbance agent causing regeneration of the shrubs and trees they harvest for dams. The WGFD and the Forest have begun transplanting beaver back into historically occupied watersheds. A cooperative inventory with WGFD of occupied and historic beaver habitat was completed in the fall of 2003. This inventory will also provide an estimate on the population level of beavers on the Forest. In total, there are approximately 101,000 acres of riparian areas on the Forest, of which 42% are dominated by forested covertypes and 18% are shrub covertypes. There are a total of 1,400 miles of perennial streams and 6,000 acres of ponds and reservoirs on the Forest, at least half of which provide potential habitat for the species. Streams that are too fast due to gradient and volume of water are less likely to hold beaver, as they often lack food sources (willow, etc.) along the streambanks.

Occasionally, beaver are removed from roadside areas where culverts are routinely plugged or flooding of the road occurs. The Forest has begun retrofitting culverts to address this, and roads are also moved out of riparian areas when it is feasible to do so. Beavers may also be taken through legal trapping, as they are designated furbearers in the state. Approximately 25 beaver are removed from the Forest each year (WGFD 2000), but the WGFD restricts areas for trapping in association with population restoration needs. Trapping harvest is not likely the largest source of mortality on beaver, but rather disease. Declining amounts of aspen, which often are near stream courses, could also be having an effect on beaver due to a lack of forage and dam material.

Beaver have also been implicated as undesirable when dams are not maintained (following emigration or loss from occupied waters), and a breach occurs causing downstream streambanks to be eroded. However, this is typically not a problem where streambanks are stable with the desired potential vegetation such as willow and sedges. Where downstream banks are not stable, then stream channel incision can occur. This can occur in areas where livestock grazing, wildlife browsing, or recreation disturbances have degraded riparian conditions.

As beaver are ecological engineers associated with healthy, functioning riparian areas, they were selected as an MIS. Many other wildlife species are associated with beaver pond habitat including waterfowl, amphibians, riparian associated songbirds, waterfowl, and aquatic invertebrates (McKinstry et al. 2000). In addition, riparian conditions associated with other uses (grazing, recreation) have an affect on beaver habitat and populations. Beaver populations may also fluctuate in response to disease, such as tularemia. Where stable colonies of beaver occur, individuals disperse from them yearly colonizing other habitat. Beaver are capable of overland travel, but mainly follow stream corridors. Beaver are prey for coyotes, bobcats, and other predators. For further information, refer to the species assessment in the administrative record.

ENVIRONMENTAL CONSEQUENCES

BEAVER HABITAT

Direct and Indirect Effects

Beaver habitat is expected to improve for all alternatives as livestock grazing standards and guidelines are implemented, dispersed recreation sites are managed, and wildlife browsing is monitored to provide feedback to population objectives. Livestock grazing is likely the largest potential threat of the management activities considered, followed by dispersed recreation. Reintroduction work in association with the WGFD would occur regardless of alternative, and guidelines to reduce killing in association with road maintenance would also occur for all alternatives. With combined habitat and transplant improvements, it is expected that beaver populations will increase under all alternatives; population growth should be similar under all alternatives. Continued coordination with WGFD would occur to select suitable trapping sites, as this is a guideline. The Monitoring Plan lists the expected monitoring procedure for this MIS.

Where beaver are limited in dispersal, it is often associated with road networks in riparian areas. The Forest would likely be reconstructing some of these roads in the next planning period, moving them out of riparian areas where possible, or decommissioning riparian area roads. There would not likely be any roads constructed along riparian areas due to implementation of riparian protection measures, though roads may cross these areas. Culverts installed during this planning period would be designed to avoid negative interactions with beaver. It is anticipated that approximately 4 miles of road per year would be reconstructed or de-commissioned, regardless of alternative, as this is largely a funding related activity. Refer to the Biodiversity section for anticipated road construction, and the aquatics section for the number of stream crossings anticipated by alternative.

The least amount of new construction would occur in Alternative C, followed by B, D-DEIS, and D-FEIS, with the most new construction likely in Alternatives A and E. However, the most reconstruction would also occur in the reverse order for alternatives, potentially

removing problem roads from riparian areas. In other words, where more active construction is needed, more reconstruction or removal of problem roads could also occur. Conversely, the alternatives with the most roadless areas would offer the lowest potential for negative interactions with beaver, reducing human access into habitats. Roadless areas are maximized in Alternative C, followed in order by Alternatives B, D-FEIS, D-DEIS, A, and E.

Cumulative Effects

In general, cumulative effects are assessed for the Forest and the lands adjacent to it within three miles of its boundary based on average elk use patterns. The period considered for this analysis is the anticipated life of the plan, 10-15 years. Cumulative effects include the past, present and reasonably foreseeable future actions, as mentioned in the summary of activities table in the introduction to this chapter. From this table, for beaver, the past and present activities of vegetation management (including livestock grazing), roads, and water quality are the most significant, and the reasonably foreseeable future activities of subdivisions and increased recreation use (OHV, demographics) are most significant. These uses could increase more developed demands on the Forest in riparian areas, possibly creating a more difficult situation in which to manage for beaver.

There would not likely be a difference in provision of habitat by alternative, though there is some risk associated with additional road crossings in Alternatives A and E. Beaver populations are likely to increase under all alternatives due to reintroduction efforts. Trapping mortality may reduce some populations, though as habitat improves in riparian areas, trapping should be less of an impact due to higher populations. Beaver habitat on the Forest would likely improve slowly in response to management reduction in roads along riparian areas, and management to reduce recreation impacts on riparian areas.

Beaver are noted to frequently occur adjacent to the Forest and throughout the Big Horn Mountains ecosection, though populations may be higher on the Forest. Often, more aggressive removal of beaver occurs in areas adjacent to the Forest due to the conflicts with irrigation diversions. However, several ranches in the surrounding plains have also begun reintroducing beaver as a means of habitat enhancement (Jellison 2003). Habitat condition on the land surrounding the Forest may have less potential, due to the more developed or more intensively used nature of these lands. Certainly the higher moisture regime on the Forest improves its carrying capacity for this species, though the gradients of some streams may be limiting. There is no anticipated increase in the demand for trapping of this species. Elements of climate (drought or flooding) would likely be the largest impact on both habitat and populations for this species aside from the direct impact of disease.

The following table provides an illustration of how plan alternatives would contribute to cumulative effects for this species and the habitats it represents.

Table 3-69. Relative impact of alternatives on beaver.

Land Use Category	Less Impact← Relative Impact →More Impact to beaver					
Effects from land authorizations	No difference between alternatives					
Effects from motorized recreation mgmt. (potential for user created roads and increased dispersed recreation use associated with anticipated road construction)	C	D-FEIS	B	D-DEIS	A	E
Effects from livestock grazing	No difference between alternatives					
Effects from timber harvesting (tie to increased potential for road crossings on streams)	C	B	D-DEIS	D-FEIS	A	E
Effects from utility corridors and additional development of land	No difference between alternatives					
Land available for locatable minerals and oil and gas	C	B	D-DEIS	D-FEIS	A	E

AFFECTED ENVIRONMENT RED-BREASTED NUTHATCH HABITAT

Red-breasted nuthatches are a non-migratory, native avian species on the Forest. They are widespread in distribution in coniferous forests on the Bighorn and throughout Wyoming. They are associated with mature structural stages, primarily due to their association with soft snags for nesting cavities, and from both insects in bark and cone crops as forage. They would be most strongly associated with Habitat Structural Stage 4C and old growth. They would also likely occur in stages 4A and 4B, and have been known to occur in the younger stages if snags are present. For information on habitat structural stages, old growth, and snags, refer to the Biodiversity section of this chapter. Currently, approximately 34% of the forested habitats are in structural stage 4, of which approximately 60% (145,000 acres) is in the 4C category. This is within the range of what likely historically occurred on the Forest (Romme 2002, Knight and Meyer 2003). Nuthatches are not known to be sensitive to edge or fragmentation issues, including effects of roads or timber harvest. Continued availability of their habitat (4C, snags, etc.) would be the issue of concern. Snags and habitat structural stages were described in more detail in the Biodiversity section in this chapter.

The Region 2 Habitat Capability (HABCAP) model was updated in 1993 to display habitat

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conditions for several species, including the nuthatch, as a function of structural stage distribution (Hoover and Wills 1987). In general, a high number for a model result is desirable, however it must also be recognized that it is not possible to maximize habitat conditions for all species due to different habitat requirements of those species.

For the nuthatch, the model assumes that structural stage 3 contributes 20% of optimum (100%), and all structural stage 4 is worth 100% of optimum for both feeding and cover habitat attributes. The model recognizes no differences in covertypes, snags, coarse woody debris, or other habitat attributes. The following table provides the results of this model by geographic area and Forestwide describing the current condition of **forested** acres as obtained from the CVU GIS vegetation database.

Table 3-70. HABCAP model values of existing red-breasted nuthatch habitat on Bighorn National Forest.

Geographic Area	HABCAP Value
Clear/Crazy	37%
Devils Canyon	65%
Goose Creek	39%
Little Bighorn	57%
Paintrock	52%
Piney/Rock	41%
Shell	57%
Tensleep	52%
Tongue	43%
Forestwide	47%

As less than 20% of forested acres have had harvest activities on them forestwide, the existing condition is largely a result of the natural disturbance processes that have shaped structural stage distribution. An example of this would be the results for Piney/Rock Creek Geographic Area. Most logging activity, historical and current, has taken place in the Clear Creek/Crazy Woman Creek and Tongue River watersheds. The 1985 plan used a similar version of HABCAP and established a general management direction of providing a minimum of 40% habitat capability for all MIS. While this model provides results applicable to this species and those associated with it, it is important to consider the trade-offs among goals for habitat capability across species. Depending on past disturbance (e.g., fire, blowdown, insect induced tree mortality) and goals for management of other wildlife, goals for nuthatches should vary among geographic areas.

Since 2002, the Forest has undertaken avian point count monitoring to improve its information available on population trends for several species. The nuthatch is adequately detected through this survey protocol, and baseline trends should be available by 2007. However, populations are known to fluctuate in response to cone crops. The following table

shows the initial survey results for the past three years (RMBO 2005).

Table 3-71. Number of detections of red-breasted nuthatches by habitat type from avian point-count surveys on Bighorn National Forest.

Year	High Elevation Conifer	Mid-Elevation Conifer	Montane Riparian	Sagebrush/Grass
2002	32	36	17	7
2003	34	35	5	16
2004	12	13	4	10

Observations in other than typical habitat (e.g. riparian or sage/grass) occur due to survey protocol allowing for audible detections in the naturally fragmented habitat of the Forest. Therefore, detections attributed to locations in sagebrush/grassland likely represent nuthatches in neighboring forested habitats. Statewide results from avian monitoring showed roughly stable trends for nuthatches. There is no reason to suspect that habitat changed significantly enough on the Forest between 2002 and 2004 with wildfires or to account for the magnitude in change in observations. More likely, drought and associated changes in productivity was most likely responsible for the observed changes.

As an additional source of population trend information, there are two transects run on the Forest from the Breeding Bird Survey monitoring effort, both having detections of nuthatches. One transect indicates an upward trend, and the other a downward trend; however, the breeding bird survey was not designed to assess trends associated with individual routes but instead at very broad spatial scales (areas similar to the state of Wyoming are most reasonable). At the statewide scale, Breeding Bird Survey results indicate an upward trend of 5% (Sauer et al. 2003). Determining trend with this type of data on the Forest is difficult at best due to the separation of transects, scarcity of transects, and variability of data.

ENVIRONMENTAL CONSEQUENCES

RED-BREASTED NUTHATCH HABITAT

Direct and Indirect Effects

The primary habitat factors associated with effects to red-breasted nuthatches would be both the availability and distribution of HSS 4C and old growth, and snags. Both of these elements were described in the Biodiversity section of Chapter 3.

In summary of effects to habitat from management activities, Alternatives C and B would likely provide the greatest amount of this type of habitat (4C, old growth and snags) in the next planning period. Alternative D-DEIS and D-FEIS would follow, with Alternatives A and

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E having the least of any of the alternatives, but still an adequate amount of this type of habitat within the range of HRV as designed by the snag guidelines adopted in the Revised Plan. These effects are from the results of timber harvest, though the natural processes of insects and disease and fire would continue to be the largest source of influence on the availability of 4C and old growth stages and snags. Timber harvest would only occur on suited acres, which occur in a range from 30% of the total forested acres on the Forest in Alternative E to approximately 7% in Alternative C. Recent and past harvest activities have occurred on approximately 20% of the forested acres.

The Region 2 Habitat Capability (HABCAP) model provides an indication of habitat availability as a function of the structural stages (Hoover and Wills 1987). Results from anticipated timber harvest activities are summarized at the forestwide scale in the following table by alternative, but do not include estimates from natural disturbances that will likely occur. It is estimated that at least one 10,000 acre wildfire will occur in the next decade, and a similar number of acres of insect and disease. Refer to the Fire and Fuels, and Insects and Disease sections of this chapter for further information. Prescribed fire was not included in the HABCAP as the effects anticipated to forested areas were anticipated to be minimal (less than 10,000 acres in the next decade). Model results are from forestwide results, whereas timber harvest would occur in more limited areas where suited acres occur, resulting in site specific alterations in habitat within certain geographic areas as compared to the forestwide scale.

Table 3-72. HABCAP model values of red-breasted nuthatch habitat by alternative at 10- and 50-year intervals.

Alternative	HABCAP Value – 10 Year	HABCAP Value – 50 Year
C	47%	66%
B	47%	65%
D-DEIS	47%	65%
D-FEIS	46%	65%
E	46%	64%
A	46%	61%

In general, the tables shows little difference among alternatives in habitat for this species at the forestwide scale, and that forest structure continues on a trajectory towards mature structure stages when the only disturbance examined is timber harvest. Even a conversion of 20,000 acres by fire to young structural stages in the first decade (10,000 acres lodgepole, 10,000 acres spruce-fir) would produce only a 3% reduction in the HABCAP value, which would be similar for all alternatives, regardless of decade.

The most specific removal of snag habitat occurs with firewood harvest. This effect typically only occurs within a few hundred feet along open roads. Where additional roads are constructed in support of harvest activities, there would be more of this type of habitat

removed. Again, this would be most in Alternatives E and A, decreasing with D-DEIS, D-FEIS, B, and least in C. However, it is also likely that due to the large expanses of habitat away from roads remaining, more than adequate snag abundance would be provided regardless of alternative, and desirable snag abundance levels would still be ensured in project areas, even following harvest. Timber modeling indicates that regardless of alternative, the forested acres would continue to mature with an abundance of mature structural stages. Wildfires and prescribed burns would create snags by killing live trees, and mosaic patterns typically leave green recruitment trees for future snags.

With regards to effects to forestwide populations, it could be assumed that populations would follow the trend of the habitat as discussed above, which would largely be driven by natural disturbance processes. However, as with any wildlife species, elements of climate would have a strong influence, affecting forage and prey available and thereby reproduction success. Red-breasted nuthatches are relatively unaffected by human disturbance. As with other passerines, active nests could be occasionally removed through timber and firewood harvesting. However, as only a few hundred acres of commercial harvest or firewood harvest are typically active in any given breeding season, this effect is thought to be minimal and undetectable to populations, particularly at the forestwide scale. The Revised Plan implements the measures required by the Migratory Bird Executive Order 13186 by providing appropriate management direction, monitoring, and consideration of rare species.

Anticipated activities (prescribed fire, commercial harvest, and wildland fire use) in all alternatives that may change habitat are all viewed as “maintaining” the habitat through time as desired by the forestwide strategy in the Revised Plan. A diversity in age class structure may help prevent more widespread losses of habitat, and/or create resiliency to disturbance, even though habitat may actually be “reduced” in the short term through disturbance activities.

Cumulative Effects

In general, cumulative effects are assessed for the Forest and the lands adjacent to it within three miles of its boundary. The period considered for this analysis is the anticipated life of the plan, 10-15 years. Cumulative effects include the past, present and reasonably foreseeable future actions, as mentioned in the summary of activities table in the introduction to this chapter. From this table, for the nuthatch, the past and present activities of vegetation management are the most significant, and the reasonably foreseeable future activities of subdivisions and vegetation treatments on adjacent lands are most significant. These uses could reduce habitat available for nuthatches adjacent to the Forest, placing a higher value on habitat provided on the Forest.

The Forest would continue to be influenced by the natural disturbance processes, and only secondarily by timber harvest or prescribed burns. Alternatives A and E would have the most potential for timber harvest and fuelwood harvest, which can lower the number of snags in an area for this species. Logging activities and firewood harvest occur on private lands adjacent to the Forest, though this is typically limited by slope and road access, and occurs mostly in the southeast corner of the Forest.

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As the Bighorn National Forest has the majority of the coniferous habitat in the Big Horn Mountains ecosection, populations of this MIS would be relatively unaffected by treatments occurring in other areas of the mountain range. This bird is not hunted, but populations fluctuate in response to abundance of cone crops and insects. It is anticipated that populations would continue similar to current levels and trends in all alternatives, with some potential for reductions in Alternatives A and E due to reduced habitat abundance in the long term if snags and mature conifer conditions are reduced in association with timber harvest activities. The following table illustrates the cumulative effects of the alternatives considered.

Table 3-73. Relative impact of alternatives on red-breasted nuthatches.

Land Use Category	Less Impact ← Relative Impact → More Impact to nuthatch habitat					
Effects from land authorizations	No difference between alternatives					
Effects from motorized recreation mgmt.	No difference between alternatives					
Effects from livestock grazing	No difference between alternatives					
Effects from timber harvesting (tie to reduced snag and mature conifer habitat potential)	C	B	D-DEIS	D-FEIS	A	E
Effects from utility corridors and additional development of land	No difference between alternatives					
Land available for locatable minerals and oil and gas	C	B	D-DEIS	D-FEIS	A	E

AFFECTED ENVIRONMENT RED SQUIRREL HABITAT

Red squirrels are a native, non-migratory small mammal on the Forest. They are widespread in distribution in coniferous forests on the Bighorn and throughout Wyoming. They are associated with mature structural stages, primarily due to their association with soft snags and coarse woody debris for nesting cavities, and cone crops as forage (Koprowski 2005). Squirrels are most strongly associated with Habitat Structural Stage 4C and old growth. They also commonly occur in stages 4A and 4B, and 3B and 3C. For information on habitat structural stages, old growth, and snags, refer to the Biodiversity section of this chapter. Currently, approximately 34% of the forested habitats are in structural stage 4, and 145,000 acres or 20% of the forested acres are in structural stage 4C. The spatial extent of these structural conditions is within the range that likely occurred most commonly during the past (Romme 2002, Knight and Meyer 2003). Squirrels are not known to be sensitive to edge or effects of roads, nor are they sensitive to human disturbance in terms of behavior modification. They would be sensitive to modifications in structural stage that would occur

through natural disturbances or timber harvest or prescribed fire. Continued availability of their habitat (4C, coarse woody debris, snags, etc.) would be the issue of concern. Coarse woody debris, snags, and habitat structural stages were described in more detail in the Biodiversity section in this chapter. They are more dependent on coarse woody debris than the red-breasted nuthatch.

The Region 2 Habitat Capability (HABCAP) model was last updated in 1993 to display habitat conditions for several species, including the squirrel, as a function of structural stage distribution (Hoover and Wills 1987). The model assumes that structural stage 1 is worth 10% of optimum (100%), with maximum capability assigned to structural stage 4 only, with different covertypes taken into account (spruce-fir and lodgepole of highest value). The model recognizes no differences in snags or coarse woody debris, or other habitat attributes. The following table provides the results of this model by geographic area and Forestwide describing the current condition of **forested** acres as obtained from the CVU GIS vegetation database. The higher values reported as compared to the nuthatch indicate the squirrel's adaptability to more structural stages than the nuthatch.

Table 3-74. HABCAP model values of existing red squirrel habitat on Bighorn National Forest.

Geographic Area	HABCAP Value
Devil Canyon	76%
Little Bighorn	75%
Piney/Rock	73%
Goose Creek	72%
Shell	72%
Paintrock	70%
Tensleep	70%
Tongue	70%
Clear/Crazy	67%
Forestwide	71%

As less than 20% of forested acres have had harvest activities on them forestwide, the existing condition is largely a result of the natural disturbance processes that have shaped structural stage distribution. An example of this would be the results for Piney Creek/Rock Creek Geographic Area. Most logging activity, historical and current, has taken place in the Clear Creek/Crazy Woman Creek and Tongue River watersheds. The 1985 plan used a similar version of HABCAP from which to base compliance with the general management direction of providing a minimum of 40% habitat capability for MIS. This model provides results applicable to this species and those associated with it. However, it would not be valid from a management standpoint to maximize habitat potential for this species as natural disturbances

would have created potentially large fluctuations in habitat available at the geographic area scale.

There is no actual population trend information based on surveys currently known for the Forest. Avian point count monitoring began in 2002, and was designed to include detections of red squirrels. Results indicated that squirrels were widespread, with a positive trend occurring in number of detections (RMBO 2005). A better estimate of population trend will be available by 2007. Loud vocalizations make squirrel detection relatively easy. There are no population trends known from other areas in the state.

ENVIRONMENTAL CONSEQUENCES

RED SQUIRREL HABITAT

Direct and Indirect Effects

The primary factor describing the effects to red squirrels would be both the availability and distribution of HSS 4A, B, C, and old growth, coarse woody debris, and snags. These elements were described in the Biodiversity section of this chapter.

In summary of effects to habitat from management activities, Alternatives C, and B would likely provide the greatest amount of this type of habitat in the next planning period. Alternative D-DEIS and D-FEIS would follow, with Alternatives A and E having the least of any of the alternatives, but still an adequate amount of this type of habitat within the range of HRV. These effects are from the results of timber harvest, though the natural processes of insects and disease and fire would continue to be the largest source of influence on the arrangement of structural stages and availability of coarse woody debris and snags.

The Region 2 Habitat Capability (HABCAP) model provides an indication of habitat availability as a function of the structural stages (Hoover and Wills 1987). Results from anticipated timber harvest activities are summarized in the following table by alternative. Prescribed fire was not included as the effects anticipated to mature timber were minimal. Timber modeling did not take into account wildfires or insects and disease. Even if 20,000 acres total of fire and insects and disease occurred, a difference of approximately 2% in the model values would be evident in the first decade at the forestwide scale (i.e., 77% instead of 79% for Alternative A).

Table 3-75. HABCAP model values of red squirrel habitat by alternative at the 10 and 50 year intervals.

Alternative	HABCAP Value – 10 Year	HABCAP Value – 50 Year
C	74%	83%
B	73%	82%
D-DEIS	73%	81%
D-FEIS	73%	81%
A	72%	79%
E	72%	79%

The most specific removal of coarse woody debris and snag habitat occurs with firewood harvest. This effect typically only occurs within a few hundred feet along open roads. Where additional roads were constructed in support of harvest activities, there would be more of this type of habitat removed. Again, this would be most in Alternatives E and A, decreasing with Alternatives D-DEIS and D-FEIS, B, and least in C. However, it is also likely that due to the large expanses of habitat away from roads remaining, more than adequate coarse woody debris and snag abundance would be provided regardless of alternative, and minimum abundance levels would still be ensured in project areas, even following harvest. Distribution would also remain relatively even over the Forest due to the expanses of non-harvestable areas.

With regards to effects to forestwide populations, it could be assumed that populations would follow the trend of the habitat as discussed above, which would largely be driven by natural disturbance processes. However, as with any wildlife species, elements of climate would have a greater influence, affecting forage availability and thereby reproduction success. Red squirrels are relatively unaffected by human disturbance. Population trend monitoring would need to be associated with changes in known habitat conditions at the sites surveyed to display any effects. The anticipated change in habitat, its association to the forestwide strategy in the Revised Plan for MIS, and effects on population changes from these habitat changes would be similar to those described for the red-breasted nuthatch.

Cumulative Effects

In general, cumulative effects are assessed for the Forest and the lands adjacent to it within three miles of its boundary. The period considered for this analysis is the anticipated life of the plan, 10-15 years. Cumulative effects include the past, present and reasonably foreseeable future actions, as mentioned in the summary of activities table in the introduction to Chapter 3. From this table, for the squirrel, the past and present activities of vegetation management are the most significant, and the reasonably foreseeable future activities of subdivisions and vegetation treatments on adjacent lands are most significant. These uses could reduce habitat available for squirrels adjacent to the Forest, placing a higher value on habitat provided on the Forest.

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The Forest would continue to be influenced by the natural disturbance processes, and only secondarily by timber harvest or prescribed burns. Alternatives A and E would have the most potential for timber harvest and fuelwood harvest, which can lower the number of snags in an area for this species. Logging activities and firewood harvest occur on private lands adjacent to the Forest, though this is typically limited by slope and road access, and occurs mostly in the southeast corner of the Forest.

As the Bighorn National Forest has the majority of the coniferous habitat in the Big Horn Mountains ecosection, populations of this MIS would be relatively unaffected by treatments occurring in other areas of the mountain range. This squirrel is hunted, though the amount killed is low. Approximately 90 squirrels were taken in 2001, by 27 hunters on the Bighorns (WGFD 2001), though more are taken from unreported shootings. As described previously with the red-breasted nuthatch, a few hundred acres are active annually for commercial timber harvest, indicating a low probability that any snags with young that could be potentially lost would have any impact or detectable difference on the forestwide population. Populations fluctuate primarily in response to abundance of cone crops. It is anticipated that populations at the forestwide scale would continue similar to current levels in all alternatives, with some potential for localized reductions in Alternatives A and E in the long term. The following table illustrates the cumulative effects of the alternatives considered.

Table 3-76. Relative impact of alternatives on red squirrel.

Land Use Category	Less Impact ← Relative Impact → More Impact to red squirrel					
Effects from land authorizations		No difference between alternatives				
Effects from motorized recreation mgmt.		No difference between alternatives				
Effects from livestock grazing		No difference between alternatives				
Effects from timber harvesting (tie to reduced snag and mature conifer habitat potential)	C	B	D-DEIS	D-FEIS	A	E
Effects from utility corridors and additional development of land		No difference between alternatives				
Land available for locatable minerals and oil and gas	C	B	D-DEIS	D-FEIS	A	E

AFFECTED ENVIRONMENT BREWER'S SPARROW HABITAT

Brewer's sparrows are a migratory species that is known to nest and rear young on the Forest. They are widespread in distribution in sagebrush habitats on the Bighorn and throughout

Wyoming. They are associated with mature canopies in sagebrush, primarily due to their selection of nesting sites. They migrate to winter in the southwest U.S. and Mexico.

As the Forest lacks detailed information to describe conditions of sagebrush habitat forestwide, a more qualitative description is used. From the CVU GIS vegetation database, approximately 262,000 acres of sagebrush habitat types occur, primarily on the west side of the Big Horns. It is unknown what percentage of this is in the mature condition (canopy cover greater than 25%) versus a more grass dominated stage. However, as described in the fire and fuels section in this chapter, the sagebrush community is regarded as being in mature condition forestwide. This is a result of having missed several fire events due to fire suppression, and reduced cover of fine fuels as a result of livestock grazing. Another example is a recent assessment conducted for the Forest in the Tensleep drainage. It concluded that the area was dominated by mature sage conditions, with aerial photo mapping of the sagebrush habitats supporting the determination. The Forest does not contain the majority of this habitat type in the Big Horn Mountains ecosection. This condition may be outside HRV for this covertype.

The management challenge for this species and its habitat is retaining a balance of age class structures on the Forest that is more resilient to large-scale fires with reduced risk of noxious weed invasion following. Prescribed burning, wildfire, and to a lesser extent noxious weeds and livestock grazing are issues of concern for this species. There were no suitable habitat models available for this species from which to describe current habitat or from which to evaluate effects of alternatives.

Avian point count monitoring began in 2002 on the Forest, indicating that Brewer's sparrows were widespread, though at relatively low abundance in the sagebrush-grassland habitats monitored (RMBO 2005). The following table shows these observation records.

Table 3-77. Number of detections of Brewer's sparrows by habitat type from avian point-count surveys on Bighorn National Forest.

Year	High Elevation Conifer	Mid-Elevation Conifer	Montane Riparian	Sagebrush/Grass
2002	2	5	3	78
2003	0	3	3	100
2004	11	5	6	81

Observations in other than typical habitat (e.g., riparian or sage/grass) occur due to survey protocol allowing for audible detections in the naturally fragmented habitat of the Forest. Loud vocalizations make their detection relatively easy. Therefore, detections attributed to locations in forested habitats likely represent sparrows in habitats neighboring sage/grass habitats. Population trends from this monitoring effort should be available beginning in 2007, after five years of monitoring. Results from statewide avian monitoring for the same period indicate a strong positive trend. This may indicate differences in sampling power, climate related factors or factors off of the Forest influencing populations. There has been little

change (less than 500 acres) in habitat on the Forest in three years, so this is not likely influencing the population trend to date.

As an additional source of population trend, there are two transects run on the Forest from the Breeding Bird Survey monitoring effort, both having detections of Brewer's sparrows. Both routes indicate a substantial decline, however the statistics surrounding these observations are not reliable. However the breeding bird survey was not designed to assess trends associated with individual routes but instead at very broad spatial scales (areas similar to the state of Wyoming are most reasonable). At the statewide scale, Breeding Bird Survey results indicate a 1% downward trend, with similar unreliability of data (Sauer et al. 2003). Determining trend with this type of data on the Forest is difficult at best due to the separation of transects, scarcity of transects, and variableness of data. Unreliability is a function of sample size and variableness of data, among other functions.

ENVIRONMENTAL CONSEQUENCES BREWER'S SPARROW HABITAT

Direct and Indirect Effects

Effects from Prescribed Fire and Fire Management: The most extensive effects to Brewer's sparrow habitat will continue to be from prescribed fire and wildfire. The Forest has traditionally conducted prescribed burning in this habitat type. Historically, this was done to generate forage for livestock, but more recently has been focused on the need for a diverse canopy cover of sagebrush, with fuels treatment money providing the impetus. Most of these treatments have been focused in the Shell Canyon, Horse Creek Mesa, and Sunlight Mesa in the past decade. Additional treatments are planned for portions of Tensleep Canyon and Tongue River watershed. None of these have reduced mature canopy covers in these locales below approximately 40% of the overall habitat available. Forestwide, the following acres are possible in all grass/brush habitat types by alternative, of which sage is the largest component.

Table 3-78. Acres of non-forested prescribed burning or mechanical habitat treatment on Bighorn National Forest.

Alternative B	Alternative D-FEIS	Alternative D-DEIS	Alternative E	Alternative A	Alternative C
3,000	2,600	2,500	2,500	2,000	1,500

With continued management direction for a diversity of age classes in shrub habitats, and with direction to follow the sage grouse management guidelines, it is not likely that enough prescribed burning would take place forestwide to significantly alter the condition class of sagebrush with regards to the overall fire regime, given continual growth occurring as well.

The prescribed burning would be viewed as “maintaining” habitat as it relates to the forestwide strategy and objective for emphasis species (MIS). However, the extent of quality habitat will be reduced in the short term through wildfire (anticipated) and prescribed burning. None of the levels anticipated would likely provide enough of an effect on the forestwide population to be detectable, however.

Project specific improvements would occur, though uncertainty exists as these areas regenerate over time, as more acres would continue to move into a higher condition class than are possible to treat. This also assumes that no large-scale wildfires occur, though some would certainly occur in the next planning period and in the long term. Due to their locations near the edge of the Forest, there may be less opportunity for sagebrush sites to fall under the wildland fire use prescriptions where larger fires could occur. There may be some variation in this effect by alternative, as alternatives with more areas in Management Categories 1 – 3 may result in larger fires, such as Alternatives B and C.

As prescribed fire would not likely occur in areas with noxious weed infestations due to forestwide direction, there is not an anticipated spread of weeds as a result of this activity. In addition, prescribed burns are typically conducted in cooler seasons to avoid detrimental effects to soils. Noxious weeds would more likely spread after wildfire events that occur under more severe conditions, where soil disturbance is more active. Prescribed burning is also not typically conducted during the breeding season for these birds, indicating a minimal chance for any loss of nests due to this type of activity.

Effects from Livestock Grazing and Non-native Species (Noxious Weeds): Forestwide direction for livestock grazing and noxious weed management has been improved in the Revised Plan, though levels of either activity do not vary by alternative. There would likely be little difference to sagebrush habitats among alternatives with regards to effects of management for these activities or resources. Livestock grazing can provide a direct transfer mechanism for establishment of noxious weeds to new sites on the Forest. As there are no anticipated increases in livestock grazing, expansion opportunities are limited to the rates currently occurring. Rates currently occurring may result in a loss of a few hundred acres of sagebrush habitat, though it is not anticipated to be in the thousands of acres in the next planning period.

Livestock grazing can also affect migratory birds by increasing cowbird parasitism. With rotational grazing systems and later turn-out dates (after June 15th) typically used on the Forest, these effects are minimized. Cowbird parasitism is not likely a large effect on Brewer’s sparrows on the Forest, though they may be to more riparian-dependent species. Livestock grazing may facilitate conditions for Brewer’s sparrow by contributing to the persistence of mature sagebrush canopies, as fine fuels can be reduced, lowering chances for wildfire.

Effects from Dispersed Recreation and Travel Management: If increased road construction occurs in Alternatives A and E, there may be some risk of noxious weed introduction where roads are constructed in sagebrush. There would likely be little difference in the other alternatives with regards to this effect. Roads have been shown to cause both habitat loss, and disturbance to nesting birds depending upon traffic volume (Ingelfinger

2001). It is not thought that the current level of development (roads and trails) is having a significant impact on existing populations, due in part to low traffic volume, and relatively low road densities in most habitat areas. User-created trails and roads have the potential to disturb additional habitat and introduce noxious weeds. This effect would continue regardless of alternative, though it may be higher in alternatives where motorized recreation opportunities are more prevalent, such as in Alternatives A and E.

Dispersed campsites would likely continue to expand into this habitat type, creating some effects, as campsites are moved away from riparian areas in accordance with plan direction.

Cumulative Effects

In general, cumulative effects are assessed for the Forest and adjacent lands within three miles of the Forest boundary, though the species range is considerably farther as habitat continues throughout the basins surrounding the Forest. The period considered for this analysis is the anticipated life of the Revised Plan, 10-15 years. Cumulative effects include the past, present, and reasonably foreseeable future actions, as mentioned in the summary of activities table in the introduction to this chapter. From this table, for the sparrow, the past and present activities of vegetation management (including livestock grazing) and land development (BLM coalbed methane) are the most significant, and the reasonably foreseeable future activities of subdivisions and vegetation treatments (e.g., BLM prescribed burns) on adjacent lands are most significant. These uses could reduce habitat available for sparrows adjacent to the Forest, placing a higher value on habitat provided on the Forest.

The projected amounts of prescribed burning, regardless of alternative, would not likely create a condition where populations of birds are significantly affected on the Forest by reductions in mature sagebrush canopy. With the current habitat being outside of HRV, it is desirable to manipulate some of this to achieve more balance in terms of age class diversity.

While increased road building evident in Alternatives A and E carries some risk to the habitat type both from a loss of habitat and introduction of weeds, the amount of habitat lost may not be significant. This is because most access roads already exist where necessary in sagebrush types, and minimal additional habitat would be lost to this use.

Lands adjacent to the Forest would likely have higher impacts to habitat both through increased wildfire and noxious weed expansions due to the drier moisture regimes and additional sources of disturbance on private lands. Cheatgrass is also a common element off of the Forest that may expand, with loss of habitat value to Brewer's sparrows and other sagebrush obligates. As weeds and undesirable species increase on lands adjacent to the Forest, this may increase the potential for the spread of these onto the Forest.

Population trends on the Forest may continue to decline for the Brewer's sparrow, particularly given largely unknown effects on its winter range in the southwest U.S. and Mexico. This may place a higher value of retaining mature sagebrush canopies on the Forest to counteract the shrinking availability of this habitat on surrounding lands and regions. However, this is currently unknown, and leaving the habitat on the Forest in a more dense condition than historically occurred could set up the Forest for larger fire events that could reduce habitat

availability even further, with increased potential for noxious weeds. For a more in-depth analysis of this species, refer to the Biological Evaluation (FEIS Appendix K). The following table illustrates the cumulative effects of the alternatives considered.

Table 3-79. Relative impact of alternatives on Brewer's sparrow.

Land Use Category	Less Impact ← Relative Impact → More Impact to Brewer's sparrow					
Effects from land authorizations	No difference between alternatives					
Effects from motorized recreation mgmt. (potential for user created roads and increased dispersed recreation use associated with anticipated road construction)	C	D-FEIS	B	D-DEIS	A	E
Effects from livestock grazing	No difference between alternatives					
Effects from timber harvesting (potential for increased loss of habitat due to road construction)	C	B	D-DEIS	D-FEIS	A	E
Effects from utility corridors and additional development of land	No difference between alternatives					
Land available for locatable minerals and oil and gas	C	B	D-DEIS	D-FEIS	A	E

Demand Species

As mentioned previously, Demand Species are selected due to their social value, primarily that associated with hunting or other commercial values. Demand species were recommended by the WGFD, and include **mule deer, moose, black bear, mountain lion, wild turkey, blue grouse, ruffed grouse, sharp-tailed grouse, chukar, and gray partridge**. The existing condition for each species' habitat and their population trend, where known, is described, along with the likely consequences of plan implementation to habitat and populations from the various alternatives. A summary of cumulative effects from alternatives is presented in a table in the end of this section.

Small game species and other species important to people for aesthetic, consumptive, or other reasons such as red squirrel (covered under MIS), snowshoe hare, and cottontails occur on the Forest but were not selected as demand species. All of these species utilize habitats as analyzed through other species, and none of them have population trends that are of concern. Fur-bearers including marten (Sensitive), beaver (MIS), badger, bobcat, mink, weasel, and muskrats all occupy the Forest, and are considered analyzed through other species and habitats. River otters were likely extirpated in the early or mid 1900s, with no known plans to reintroduce them.

AFFECTED ENVIRONMENT

MULE DEER AND MOUNTAIN LION HABITAT

Mule deer are largely generalists in terms of the habitat they occupy, including meadows and shrub-steppe for foraging and timber for cover. Due to this factor, they were not considered as an MIS in the Revised Plan. Mountain lions closely follow mule deer herds, and thus were included together. Mountain lions prefer areas with rock outcrops or cliffs for escape cover and hunting, though they are also capable of exploiting a variety of habitats and are capable of long-range movements.

The Forest provides mostly summer and spring/fall transition range for deer, though areas of winter range occur as identified by WGFD mapping efforts. No crucial fawning habitat has been mapped as this is mostly well dispersed on the Forest. The 1985 plan identified winter range as a priority improvement area, with scheduled habitat treatments to improve winter range. These improvements were not conducted as planned, though some prescribed burns in the past decade (e.g., Tongue River Canyon, South Slope burns near Buffalo, planned Little Bighorn) have benefited winter range.

Summer range conditions are generally good on the Forest, with some localized areas of degraded conditions due to the combined forage use of domestic and wild ungulates. Key habitats include riparian (willow), meadows, and aspen. Shrubs on winter range are comprised primarily of mature conditions, with the exception of where recent burns have taken place. Deer avoid roads primarily during hunting season, though they are less sensitive to road influences and disturbance than elk. Mountain lions have shown preferences for areas with lower road density to avoid being hunted (Van Dyke et al. 1986).

Population trends west-wide for mule deer are down from the higher levels noted in the 1950s and 60s, with speculated reasons including competition among ungulates, reduction in predator control, and habitat degradation or loss, primarily on winter ranges. Population estimates are provided by the WGFD and are based on harvest data and aerial post harvest counts conducted on winter range. The following table indicates a similar trend for those herds that occupy the Bighorn National Forest for at least a portion of the season. Geographic locations (maps) of Hunt Areas are described in WGFD hunting regulations.

Table 3-80. Mule deer herd objectives, populations, and hunter success by herd unit and hunt area (2002).

Herd Unit/Hunt Area	Population Objective	Current Population	Hunt Strategy	Hunter Success
<i>North Bighorn HU</i>	25,000	21,000		
HA 25			General	18%
HA 28			General	21%
HA 50			General	34%
HA 53			General	32%

Herd Unit/Hunt Area	Population Objective	Current Population	Hunt Strategy	Hunter Success
<i>Paintrock HU</i>	13,000	10,000		
HA 46			General	21%
HA 48			General	12%
<i>Southwest Bighorn HU*</i>	28,000	19,260		
HA 43			General	25%

* Only a small portion of the Hunt Unit occurs on the Forest.

There are no population data available for mountain lions due to the difficulty in surveying for this species. However, quotas for hunting have been fluctuating in recent years, in response to depredation levels, research, and hunter harvest. Increases in mountain lion populations have been noted in many areas of the west, and are likely a response of reduced mortality from predator control in recent decades. Increased observations of lions off of the Forest may also indicate higher population levels on the Forest. The WGFD estimates that approximately 100 mountain lions may inhabit the Forest based on average home range sizes.

ENVIRONMENTAL CONSEQUENCES MULE DEER AND MOUNTAIN LION HABITAT

Direct and Indirect Effects

Timber harvest and roads have minor effects to mule deer habitat, though any loss of habitat due to road construction would be negative, unless other roads are closed and revegetated to mitigate the loss. Clearcuts and harvest are considered beneficial for deer due to the increase in forage. Timber harvest in some winter ranges has been done to open canopies and increase forage quantity and quality, though this has been minimally practiced in the past. Harvest levels would be greatest in Alternatives A and E, and remain largely the same as current levels in Alternatives D-DEIS and D-FEIS, with the least in Alternatives C and B. Mountain lions tend to prefer secluded areas, though largely their occurrence on the steeper edges of the Forest reduces any potential effects from harvest or road construction.

Prescribed burning would likely continue to be conducted to improve winter range conditions, though the levels conducted may not sufficiently regenerate enough ranges to meet the demand of wildlife use. An exception would be areas where mountain mahogany is a primary forage component, as fire can potentially reduce this shrub on the landscape for many years. However, the competing invasion of juniper into mahogany stands may be a result of fire exclusion. Wildfire occurrence may account for significant changes in the next planning period, as the shrublands are regarded to be in a condition where they have missed fire cycles due to suppression, and could be more susceptible to catastrophic loss of larger acreages.

There would be little difference in alternative with regards to this potential, although the proposed wilderness in Alternative C in the Rock Creek area may influence small acres of winter range with regards to fire suppression, possibly increasing the potential for loss in this area.

Although winter range would be managed regardless of alternative, it is most emphasized in Alternatives D-DEIS, D-FEIS, B, and A, respectively, with E and C having less but similar levels as described in the table below.

Table 3-81. Big game winter range prescription acres by alternative.

Mgmt. Area	Alt. D-FEIS	Alt. D-DEIS	Alt. B	Alt. A	Alt. E	Alt. C
5.41	34,865	28,852	28,213	27,680	23,452	21,325

Human disturbance on big game winter range has been of increased concern, primarily due to the stress imposed on big game for activities such as antler hunting. Similar to the 1985 plan, the revised plan would designate travel closures to motorized vehicles in winter range, except where main arterial roads and highways occur. WGFD (2002) winter range maps are the basis for delineating these areas. Refer to the administrative record for the most recent maps. Hiking and antler hunting would not be prohibited through the plan at this time. This would not vary by alternative.

Potential conflicts with livestock grazing have been of concern in both summer and winter range areas, where combined use of forage can result in degraded habitat conditions. Revised Plan direction would address this, though instances of localized problem sites would likely continue in all alternatives for the next planning period. This issue is dealt with at the individual allotment scale, and includes shrub and grasslands on winter range, as well as willow and aspen covertypes.

No management conflicts with mountain lions are currently known to occur, other than dispersed recreation use displacing lions in localized areas.

Cumulative Effects

In general, cumulative effects are assessed for the Forest and the lands adjacent to it within three miles of its boundary based on average deer/lion use patterns. The period considered for this analysis is the anticipated life of the plan, 10-15 years. Cumulative effects include the past, present and reasonably foreseeable future actions, as mentioned in the summary of activities table in the introduction to this chapter. From this table, for deer and lions, the past and present activities of vegetation management and roads are the most significant, and the reasonably foreseeable future activities of subdivisions and increased recreation use (OHV, demographics) are most significant.

Winter range is in the zone with the most potential for increases in noxious weeds and non-natives (cheatgrass) due to the elevation and lack of forested canopy cover. While possibly limited amounts of winter range would be lost by this effect in the next planning period, the

likelihood increases with time as has been demonstrated in other winter ranges in the state. Where roads, livestock grazing, recreational horse use, and wildlife use occur in these areas, those uses would be the most likely vectors. As weeds and other non-native species are expanding on private lands surrounding the Forest, this has the potential to increase risk on the Forest with similar effects. Any additional loss of winter range or other habitat on the Forest would translate into reduced carrying capacity on the Forest, eventually resulting in a downward trend or reduced population levels on the Forest. Any reduction in mule deer herds would translate similarly into a reduction in lion populations.

In addition, continued growth of housing developments in areas adjacent to the Forest may reduce carrying capacity of winter range. This may place a higher value on the availability and condition of winter range on the Forest. Lions are less displaced by human activity as deer, as they are largely nocturnal. The few lions that may be taken annually either due to hunting or predator control have not been shown to decrease the overall population trend. Any anticipated increases in road densities from management activities would not likely alter the level of mortality for lions due to vehicles, as no higher speed roads (highways) would be developed. However, improved access could result in improved hunting success or increased poaching, but may also displace lions, so there is no measurable difference anticipated, particularly given lion preferences for habitat along the Forest boundaries, which are too steep for additional road construction in general. The proliferation of user-created roads on the Forest could continue to be of concern in the next planning period, as habitat loss or disturbance may occur to deer, and consequently lions.

Disease may continue to play an increased role in the abundance of mule deer herds, though currently this portion of Wyoming is thought to be minimally impacted by diseases such as chronic wasting disease. Displacement of mule deer by white-tailed deer may occur in localized areas, as white-tailed deer appear more able to persist with increased human occupation in lands adjacent to the Forest.

The subject of mule deer population declines is currently of research interest within the state and many western states and is typically related to a combination of many of the factors mentioned above.

Climate (drought and winter severity, annual forage production), hunting, and vehicle-related mortality would continue to be the primary factors associated in determining population levels and trends for both species. Forage quality on the Forest can also affect the condition of deer heading into winter ranges, with competition by livestock and increasing noxious weeds being a potential problem. Yearly coordination meetings will continue to be held with the WGFD to discuss habitat conditions and population objectives. There would not likely be a difference among alternatives overall with regard to deer and lion habitat and populations in the foreseeable future.

AFFECTED ENVIRONMENT MOOSE HABITAT

Moose are a desirable non-native species introduced to the Big Horns beginning in 1948 with additional supplemental releases. Since their release, moose have thrived on the Bighorns, and have become a favorite wildlife viewing species along highways and roads. Moose are typically not sensitive to road densities and human disturbance, except in hunting season. Moose on the Bighorn National Forest are also a highly sought after hunting trophy.

Primary moose habitat involves willow riparian communities primarily for summer range, though year-round use occurs to some extent depending on geographic location on the Forest. Winter habitat and escape cover is associated primarily with spruce-fir forests, typically on north aspects, though use of lodgepole is also common. Mature conditions (multi-storied in spruce-fir) are preferred by moose.

Moose are managed as one herd unit on the Forest, with four separate hunt areas as described in the table below. Populations are estimated from aerial and ground observations, though these estimates are often difficult to interpret due to difficulty in observing moose in forested habitats. The following populations are based on 2003 post-season estimates from the WGFD.

Table 3-82. Moose herd objectives, populations, and hunter success by herd unit and hunt area.

Herd Unit/Hunt Area	Population Objective	Current Population	Hunt Strategy	Hunter Success
Bighorn HU	500	455		
HA 1 (NE portion of Forest)	350	235	Limited	90%
HA 34 (SW portion of Forest)	70	140	Limited	100%
HA 42/43 (W portion of Forest)	80	80	Limited	100%

Moose concentrate their foraging in deciduous shrub and tree habitats leading to potential management conflicts. Heavy moose browsing in willow and aspen habitats, especially in areas used by livestock, can significantly reduce cover of willow or aspen. Over the long-term, moose foraging can reduce the extent of willow or aspen cover. In localized areas of the Forest, loss of willow habitat over the long-term is a concern. Over-utilization of willows may also remove sustainable conditions for beaver leading to a cascade of ecological changes as water tables drop when beaver dams fail. Aspen may also be heavily used by moose in localized areas. The Forest continues to coordinate with WGFD in identifying monitoring sites and potential issues with regard to carrying capacity of population objectives.

ENVIRONMENTAL CONSEQUENCES MOOSE HABITAT

Direct and Indirect Effects

Effects to winter habitat (mature spruce-fir) and willow (riparian) are described in the Biodiversity section (see composition and habitat structural stages). The Aquatics section also discusses riparian habitat conditions. Direct effects of management to spruce-fir are primarily associated with timber harvest, though wildfire would continue to be the main disturbance agent for this resource. Moose often take advantage of burned areas to eat sprouting shrubs and trees. Alternatives A and E would likely have the highest levels of harvest for spruce-fir, although uneven-aged harvest (selection) prescriptions would likely retain habitat values in spruce-fir. Roads do not likely have a major effect on moose.

Livestock grazing would continue to be an effect on willow communities, with improvement over time through implementation of standards and guidelines. There would be little difference by alternative with regards to effects from livestock grazing. Areas where the combination of high use by livestock and moose negatively impact willow would be addressed through allotment planning and coordination efforts with the WGFD.

Winter recreation may have an effect on moose, displacing them from some areas, such as riparian zones, where heavy snowmobile traffic may occur. Cross-country skiing is not likely of sufficient amount or intensity to displace moose. Effects from snowmobiling are generally in localized areas rather than Forestwide. Snowmobile use would be allowed to occur under all alternatives, but the amounts and types of use would vary according to any use of the 1.2 or 1.31 management prescriptions that limit snowmobile use, which would primarily be in Alternative C.

Cumulative effects

In general, cumulative effects are assessed for the Forest and the lands adjacent to it within three miles of its boundary. The period considered for this analysis is the anticipated life of the Revised Plan, 10-15 years. Cumulative effects include the past, present and reasonably foreseeable future actions, as mentioned in the summary of activities table in the introduction to this chapter. From this table, for moose, the past and present activities of vegetation management (including livestock grazing) and roads are the most significant, and the reasonably foreseeable future activities of subdivisions and increased recreation use (OHV, demographics) are most significant.

Combined livestock and wildlife browsing of willows and aspen will likely continue to be an impact throughout the next planning period, regardless of alternative. Efforts in management would continue to address bringing the use levels within the carrying capacity of the resources.

Increases in noxious weeds which affect riparian resources by decreasing native vegetation would have a negative effect on moose habitat. Effects from lands adjacent to the Bighorn National Forest are minor, as moose spend the bulk of their time on the Forest.

Moose populations would likely continue to increase in absence of additional hunting or weather related mortality. In the past, hunting pressure was applied to restrict population growth, then eased. Currently, hunting pressure is being increased to keep moose within population objectives, though this is speculative that harvest is keeping populations within objective based on data from WGFD. Past harvests were effective at regulating moose populations, though the past decade has allowed moose to expand in numbers. The WGFD and the Forest continue to strive for effective riparian habitat management for this species, other wildlife, and domestic livestock, which should allow for stable populations of moose.

AFFECTED ENVIRONMENT BLACK BEAR HABITAT

Black bears are native to the Forest, and occupy a variety of habitat types in the summer. In winter, they prefer more secluded habitats where adequate denning habitat with minimal human disturbance (rock outcrops, caves, large downed trees) can be found. Summer foraging habitat includes forests, shrublands, and riparian covertypes, though bears are considered omnivores. Black bears, like grizzlies, may also seek out human refuse as forage, raiding garbage or other sources of food. This occurs largely near campgrounds, summer cabins, and lodges located on the Forest. Management of human sources of food for black bear is critical to maintaining human safety.

Bears are largely an elusive species, and therefore seldom seen, though they are a popular species to hunt. Bear-baiting for hunting occurs on the Forest, under permit by the WGFD. Black bear population levels or trends are largely unknown due to the difficulty in surveying them, though harvest quotas are used as a surrogate similar to mountain lion populations. Populations are estimated to be stable on the Forest.

ENVIRONMENTAL CONSEQUENCES BLACK BEAR HABITAT

Direct and Indirect Effects

Effects to bears or their habitat from management activities could include an increase in disruption through increased road densities or recreation use, an increase in garbage sources from increased recreation levels (typically causing bear mortality due to human safety issues), and predator removal associated with livestock (sheep) grazing. These effects are currently

thought to be minor on overall populations. As recreation levels will likely increase regardless of alternative, the Forest added an additional guideline in the Revised Plan (see Recreation – General) to address this issue, and the Forest continues to work with the public in association with the WGFD in educating the public regarding bear interactions and food/refuse management.

Road densities, and therefore potential human disturbances, may be greatest under Alternatives A and E, and least in Alternative C, followed by B, D-DEIS and D-FEIS. There is no known threshold of road densities that eliminates black bear use of habitat, though research shows a preference for lower road density areas (Kasworm 1990). Research conducted for grizzly bears indicated that densities greater than one mile per square mile were detrimental (McLellan and Shackleton 1989). Many areas on the Forest have a low road density, as indicated by the undeveloped nature of the Forest. Approximately 53% of the Forest is in roadless areas as defined by the 2003 inventory combined with the Cloud Peak wilderness. There are also higher road densities in areas where past timber harvest has occurred.

Livestock grazing may continue to affect some forage sources for the bear, though this would not vary by alternative, and management of this use is likely to improve over time through application of forestwide standards and guidelines in the Revised Plan. Sheep grazing is at a historical minimum for the Forest, and removal of bears to reduce sheep predation (predator control) is considered minimal.

Cumulative Effects

In general, cumulative effects are assessed for the Forest and the lands adjacent to it within three miles of its boundary. The period considered for this analysis is the anticipated life of the plan, 10-15 years. Cumulative effects include the past, present and reasonably foreseeable future actions, as mentioned in the summary of activities table in the introduction to Chapter 3. From this table, for bears, the past and present activities of vegetation management and roads are the most significant, and the reasonably foreseeable future activities of subdivisions and increased recreation use (OHV, demographics) are most significant. Any increase in road densities typically reduces habitat potential for black bears as they prefer more secluded areas. There would not likely be additional mortality for bears due to road development as typically only high volume and speed roads lead to vehicle related mortality. There would not likely be any additional mortality from predator control associated with livestock grazing, as sheep grazing is at an all time low. Additional roads could lead to more potential negative human interactions with garbage from recreation use, or from additional poaching. None of these potential effects combined would likely lead to a significant or even measurable difference in black bear populations, as the natural effects of climate and prey/forage are typically the dominant effects on populations. The WGFD could adjust harvest related mortality if other factors were shown to be causing a downward trend in population levels.

Bears also occur on lands adjacent to the Forest, where human interaction leads to some displacement as impacts to human safety, or ranching, or bee-hives may be of concern. None of these mortality sources are likely to affect populations on the Forest, however.

As discussed for other wildlife species, impacts from loss of native vegetation due to non-native species would also have an effect on bears and their habitat. Loss of habitat is likely to increase under all alternatives, though increased road construction in Alternatives A and E could result in additional risks. Weed expansion from private lands via livestock and wildlife would continue as a risk in all alternatives.

Black bear populations would likely continue to be stable, with climate (forage availability) and hunting being the largest factors determining trends.

AFFECTED ENVIRONMENT

UPLAND GAME BIRD HABITAT

Upland game known to occupy the Forest include the wild turkey (Merriam's, non-native), ruffed grouse, blue grouse, sharp-tailed grouse, gray partridge (non-native), and chukar (non-native). The chukar and partridge are primarily associated with grass and shrub habitats, with the chukar occurring more frequently where rocky areas may occur and in steep canyons, with both mainly on the west side of the Bighorns. The blue grouse occurs forestwide and occupies high elevation conifer sites in the winter, but uses mid-elevation riparian sites in the spring and summer for brood rearing, along with meadows, shrublands, and timber in the fall as foraging sites. Ruffed grouse are located mostly in the northeast corner of the Forest, using primarily aspen and mountain shrub communities, with some use of conifer habitat. The turkey uses a combination of small meadows, shrub sites, and trees (roost sites), primarily only occurring in the southeast portion of the Forest. Sharp-tailed grouse (plains variety) have been known to occupy meadows and shrublands also on the southeast corner of the Forest. The Forest is best known for its role in providing hunting opportunity for blue and ruffed grouse, similar to other National Forest's in Wyoming.

Population estimates are not available for these species. Abundance of these species vary annually in response to climate (forage and nestling survival) related factors. All populations are considered stable over the long-term in suitable habitats on the Forest. Turkeys have expanded distribution on the Forest, primarily in ponderosa and lodgepole pine habitats, dispersing up riparian corridors.

ENVIRONMENTAL CONSEQUENCES

UPLAND GAME HABITAT

Direct and Indirect Effects

While timber harvest can have an affect on turkey habitat if adequate roost trees are not retained, this has not been an issue on the Forest. Management guidelines for turkey were

included in Revised Plan guidelines (see wildlife section) (CDOW 1993). Wildfire or prescribed fire would have a much larger impact on their habitat, as it tends to be at the lower elevations on the Forest where timber harvest is minimal. Ponderosa pine that has become dense due to fire suppression would benefit from habitat restoration as older, mature trees would be retained that would serve as roost trees. Refer to the Brewer's sparrow section above for anticipated levels of treatment by alternative of upland game habitat. Blue grouse also use intermittent meadows and shrublands in addition to conifer forests, with maintenance of these habitats being important. For ruffed grouse, refer to the composition section of the Biodiversity section of this chapter for aspen conditions and effects.

Livestock grazing can affect riparian, meadow, and shrubland covertypes that provide habitat for several upland game species. Grazing levels would not vary by alternative, and forestwide standards and guidelines were updated for all alternatives for this resource use to provide sustainable resource conditions. Cattle grazing may also provide benefits to species such as butterflies or other pollinators, where meadows in lower seral stages may have more occurrences of wildflowers, presuming bare ground is not increased. Grazing may also increase plant vigor in some circumstances, providing improved forage conditions for other species.

While birds are easily flushed due to human activity, they also return readily to habitats from which they are displaced. Increasing recreation use may continue to have some impacts, but the most significant effect to these species would be from habitat loss due to roads, should additional roads be constructed in their habitats and other roads not reclaimed as mitigation. Increases in road density could occur in Alternatives A and E.

Cumulative Effects

In general, cumulative effects are assessed for the Forest and the lands adjacent to it within three miles of its boundary. The period considered for this analysis is the anticipated life of the plan, 10-15 years. Cumulative effects include the past, present, and reasonably foreseeable future actions, as mentioned in the summary of activities table in the introduction to Chapter 3. From this table, for upland game, the past and present activities of vegetation management and roads are the most significant, and the reasonably foreseeable future activities of subdivisions and increased recreation use (OHV, demographics) are most significant.

Wild turkeys occur in greater abundance on lands adjacent to the Forest, as do chukar, sharp-tailed grouse, and gray partridge. Effects on these lands from habitat conversion to urban development or intensive agricultural uses or noxious weeds would have the predominant effect on these species' populations. Turkeys are thriving in cottonwood dominated riparian areas adjacent to the Forest, and many people provide supplemental feed for the birds. The native sharp-tailed grouse may be losing the most habitat of any of the species, as it is likely less adaptable than the others, and holds affinities to strutting grounds for spring courtship. Unlike most native galliformes, Chukar respond positively to cheatgrass and some other non-native plants. It is unknown to what extent the non-native bird species may be displacing the

native gallinaceous birds. Blue grouse are some of the most abundant game bird on the Forest, and likely receive the majority of hunting pressure.

Populations for each of these species would likely remain stable for all alternatives. Species dependent on meadows or early structural stages in forested conditions may benefit from increased timber harvest in Alternatives A and E. The recent introduction of West Nile virus may play a role in diminishing populations in the short term. Native birds are highly vulnerable to the virus. The most important mosquito vectors for the virus occur at lower elevations exposing most of the upland game bird species. Any potential losses of animals from Forest management activities would likely be on the magnitude of a few individuals and not contribute to any potential downward trends in populations that could possibly be attributed to more widespread losses such as disease.

Summary of Effects to Wildlife from Proposed Management Activities

Effects from Oil and Gas Leasing

Oil, gas, and minerals development can impact wildlife primarily through alteration or destruction of habitat and through disturbance (noise and human activity). Disturbance can cause displacement abandonment, increased mortality and reduced reproductive success of some wildlife species (Ingelfinger 2001). Effects are mitigated through land reclamation and restrictions on timing, location, and types of disturbance. These are implemented through standard lease terms, and standards and guidelines in the revised plan.

Oil and gas development on the Forest is expected to be minimal, and no well drilling is expected in the planning period, based on the BLM Reasonably Foreseeable Development Report. Because of this low potential, none of the alternatives are expected to have an adverse effect on wildlife.

Effects from Locatable Minerals

Potential effects from locatable minerals development are similar to oil and gas leasing. Effects are mitigated through land reclamation and standards and guidelines in the Forest Plan. Locatable minerals are available for exploration throughout the forest, except where specifically withdrawn from mineral entry.

Effects from Fisheries and Riparian Management

Managing fish and riparian habitat includes many techniques, including in-stream structures, riparian plantings, exclosure fences, and bank stabilization. Usually these management tools also result in higher quality habitat conditions for terrestrial wildlife, especially riparian-associated species. Planned activities (based on the first decade) include restoration of streams or riparian areas and restoration or enhancement of lakes and wetlands. While the stream,

riparian and lake restorations and improvements may have site-specific positive impacts on riparian associated terrestrial species, there would not be a measurable forestwide change in the first decade.

Effects from Fire and Fuels Management

Fire and fuels management can have a variety of beneficial and adverse effects on wildlife habitats. The composition, structure, function, and pattern of wildlife habitats on the forest have been influenced by fire historically, with many systems being fire dependent. Active fire suppression over the last 100 years has also played a role in native communities. Effective control of fire during the last century has resulted in forested wildlife habitats dominated by late-successional stages in low elevation covertypes, though the effect of fire suppression in lodgepole and spruce-fir has been less due to the typically longer fire return interval.

Managing fire and fuels can have a beneficial effect on wildlife habitats by increasing the diversity of vegetation, especially in early successional stages. Fire/fuels management can be used as a primary management tool for improving and stimulating changes in wildlife habitat, particularly in creating early successional conditions that are favorable to big game forage production and other species that require early seral conditions. Fire/fuels management can also have negative impacts on those species requiring dense tree or shrub canopy cover. Alternative B would likely have the most acres of prescribed fire, forested and non-forested, followed by both D Alternatives, A, E, and C respectively. While the lands restored, improved, or maintained by prescribed fire may have site-specific beneficial or adverse impacts on terrestrial species habitat, there would not be a forestwide measurable difference in most terrestrial wildlife populations between alternatives.

Effects from wildfire can have both beneficial and adverse effects. A negative aspect of fire is reduction of cover and forage caused by stand replacement fires. Loss of forage is generally short-term in nature. Alternatives with the most potential for larger wildfires would be Alternatives C and B, followed by D-DEIS, D-FEIS, A, and E respectively.

Effects from Insects and Disease Management

Forest insects and diseases have always been a natural component of the Forest. Along with fire, they are some of the most important disturbance agents that have created the current composition, structures, and pattern of wildlife habitats. The primary insect species are mountain pine beetles, followed by the spruce beetle and wood-boring insects of aspen. Primary coniferous and deciduous tree diseases include lodgepole pine dwarf mistletoe, Douglas-fir dwarf mistletoe, Armillaria root disease, and several decays and cankers of aspen. Many species of wildlife (such as the lynx, marten, and three-toed woodpecker) depend on snag and downed woody dependent species may benefit most from periods of increased insect and disease activity. Infrequent epidemic levels of activity often resulted in large stand-replacing fires that were part of the ecological processes helping to shape the current ecosystems on the forest. The infrequent epidemic outbreaks can also have negative impacts on wildlife habitats. Some examples include reductions in standing live biomass for species

associated with late-successional and old growth habitats and removal of large areas that provide cover and security habitat for big game species. The alternatives do not differ on predicted levels of endemic insect and disease levels at the forestwide scale, as these factors are primarily climate dependent events.

All alternatives may implement management actions to control, to varying levels, insect and disease infestations, mainly through timber harvesting and thinning. Timber harvesting, thinning, and related silvicultural activities can provide tools for preventing or reducing the risk of small and large insect or disease outbreaks that may have negative effects on wildlife habitats for certain species. No management actions for the control of insect and disease outbreaks are planned, but site-specific control projects may be implemented.

Based on management area allocations, Alternatives E and A have the greatest number of acres where direct suppression would be used and where insect and diseases would be actively suppressed or controlled. Alternatives C and B have the greatest predicted amounts of insects and diseases based on lack of active management. Alternatives D-DEIS and D-FEIS are between these two ranges.

Effects from Domestic Livestock Grazing

Activities related to domestic livestock grazing can have beneficial and/or adverse effects on wildlife and wildlife habitats, depending on the species. Livestock may utilize dense vegetation, stimulating new growth that increases forage nutrient content and availability, and improving habitat for species that associate with more open habitats. Adverse impacts occur when shrub or grassland communities are grazed to a level that decreases habitat quality for species associated with dense vegetation, including many ground-nesting birds. Social interaction and competition for forage, space, and water can occur between wildlife and livestock, but timing and distribution of livestock grazing can effectively reduce or eliminate the majority of these conflicts. The focus of most grazing effects is typically in riparian areas, which is also where the most wildlife species habitat use occurs. Livestock grazing may indirectly influence neotropical migratory birds through cowbird parasitism. Cowbirds are often associated with livestock herds and can reduce productivity of neotropical migratory birds. This is minimized on the Forest through the use of rotational grazing systems and later turn-out dates.

Domestic livestock grazing would continue to be permitted under all of the alternatives. Livestock management standards and guidelines apply to all MAs that permit livestock grazing, so impacts to wildlife generally will be the same under all alternatives.

Another activity associated with livestock grazing is predator control. Target species on the Bighorn National Forest are largely the coyote, with very few, if any, black bear or mountain lions taken. Some bobcats can also be potentially killed through non-target trapping impacts. These activities are undertaken by the USDA APHIS Wildlife Services. Control activities are currently primarily limited to support of domestic sheep grazing, which is at greatly reduced levels compared to historic levels. Population levels of predators are not affected at the forestwide scale through these activities, as coyotes rebound following control activities, and

other species are seldom taken. Refer to the Biological Assessment (FEIS Appendix F) for lynx on potential effects to this species, and ongoing consultation by USDA Wildlife Services.

Effects from Noxious Weeds

Controlling noxious weeds will help maintain habitat for wildlife. Noxious weeds adversely impact herbaceous cover and forage for most species, by replacing native vegetation with species that may have no forage or cover value for wildlife. Control actions are directed by the Revised Forest Plan including general direction to control noxious weed infestations and implement the forestwide noxious weed plan. It is not expected that any of the alternatives will provide adequate control to halt or reverse the spread of noxious weeds on the Forest, although rates of spread over the long-term should be reduced. The dispersal mechanisms or vectors of livestock and wildlife grazing and browsing, and recreation use would largely be the same for all alternatives. The amount of roads serving as vectors would be greatest in Alternatives A and E.

Effects from Recreation Management

Some types of recreational activities can result in direct loss of wildlife habitat, increase disturbance, and temporary or permanent displacement of species (Joslin and Youmans 1999). Effects on wildlife would primarily be associated with increased disturbance from dispersed recreationists. Any expansion or construction of new facilities would involve a loss of habitat, though this is anticipated to be minimal or non-existent for all alternatives, with the exception of a few trails and a highway rest area.

Dispersed recreation, whether motorized or nonmotorized, has the potential to disturb and displace some wildlife species. The effects of motorized use and road density on habitat effectiveness and big game hunting have been discussed under the elk security area discussion in this chapter.

Research has shown that snowmobile use has the potential to displace wildlife, can result in habitat loss, and can sometimes lead to mortality (Boyle and Samson 1985; Bury 1978, Dorrance et al. 1975). Behavioral responses can be of both short and long duration (Knight and Gutzwiller 1995). Snowmobiling can also damage non-woody plants, shrubs and saplings, reduce vegetative standing crop, and create changes in species composition, thus resulting in indirect impact to habitats. In general, these effects are small and localized, and are not known to be creating a viability issue for either rare plants or animals, or any of the MIS. There may be some fuel spillage and small, localized areas where incomplete combustion leads to oil remaining in the area possibly contaminating soil, however there are no known areas of concern currently. Ice dams created by snowmobile creek crossings can also be of concern if runoff patterns of snowmelt are affected, however this is also currently not known to be of concern in any area, as runoff is typically more rapid and under more even thaw conditions to minimize this effect. The greatest impact to wildlife appears to be on those animals that winter under the snow (subnivean) (Boyle and Samson 1985, Bury 1978). Snowmobiling effects from current levels of use were estimated for both the riparian and

meadow habitats forestwide, since these are the primary areas where snowmobiling occurs, with results shown in the following table. Snowmobiling also provides for winter wildlife viewing and research activities, resulting in positive public benefits.

Table 3-83. Acres of riparian and meadow wildlife habitat affected by snowmobiling, estimated in 2003.

Meadow/Grassland Acres	Riparian Acres*
99,578 acres within 0.5 miles of groomed/designated snowmobile routes. (42% of Total)	30,014 acres within 0.5 miles of groomed/designated snowmobile routes. (34% of Total)
35, 489 acres within Cloud Peak Wilderness (no motorized uses) (15% of Total)	15,737 acres within Cloud Peak Wilderness (no motorized uses) (18% of Total)
236, 052 acres total on Forest	88,770 acres total on Forest

* From Riparian Inventory on GIS (Girard, 1997)

From this analysis, which assumed that the majority of snowmobiling occurs within 0.5 miles of groomed routes, it is estimated that the majority of these habitat types and wildlife associated with them are not affected by snowmobiling.

Snowmobile use would be allowed to occur under all alternatives, but the amounts and types of use would vary. Where additional wilderness or nonmotorized winter recreation (Prescription 1.31) is proposed, there would be less. In order by alternative, snowmobile use would have the most potential in Alternative E followed by A, D-DEIS, D-FEIS, B, and C. In crucial big game winter range (as mapped by WGFD), winter motorized recreation is prohibited between November 15 and April 30 to minimize disturbance to wildlife. The current level of snowmobiling is estimated to increase with reduced opportunity for snowmobiling in Yellowstone National Park and from an aging population of people.

Few studies show a good understanding of the direct and indirect effects of recreational disturbance on wildlife (Knight and Gutzwiller 1995). Most studies have focused on overt behavioral responses. Minimal information or research exists that addresses possible impacts at the population or community level. The Revised Plan contains standards and guidelines which will help reduce impacts from recreational activities for some wildlife species (e.g., elk calving and winter range areas, caves, protection of known active and inactive raptor nests).

Effects from Travel Management

Roads and trails impact wildlife species by direct removal of habitat or direct mortality during construction and reconstruction or indirect loss of habitat or animals associated with increased human use and disturbance associated with the use. This loss is greatly reduced when roads are closed, re-vegetated, or decommissioned. Roads indirectly impact wildlife by providing human access to lands and therefore facilitating an array of impacts (e.g., introduction of non-native species, disturbance, hunting). Generally those alternatives proposing the fewest miles of road construction and the most miles of decommissioning pose the least risk to sensitive species and their habitat. Based on this, potential adverse effects to wildlife from travel management from most to least are Alternatives E, A, D-DEIS, D-FEIS, B, and C. Motorized

travel occurring off designated routes is prohibited in all alternatives. A potential cumulative effect to wildlife from travel management is the amount of vehicle related mortality. Due to the relatively low density of vehicles throughout the Big Horn Mountains, with use occurring primarily during daylight hours, mortality is typically low, and not thought to be of a detectable amount on forestwide populations. Vehicle related mortality is highest on higher speed limit roads, for which none of the alternatives would be promoting any increases.

Effects from Timber Management

The direct effects of vegetative management, especially timber harvest, would be an immediate change to the structure and often the composition of the treated areas. Timber management can result in both beneficial and adverse effects on wildlife.

In place of the historical disturbance agents such as fire, insects and disease, timber management can help retain the diversity of habitats and vegetative composition, structure, and pattern. Timber management and related roading can also result in loss of habitat effectiveness and increase wildlife disturbance and displacement. Cutting of dead trees and snags for firewood following logging can affect the availability of cavities for nesting and security, for snag dependent species.

All alternatives would have some level of timber harvest, although the quantity and objectives for harvesting vary by alternative. Forestwide and Management Area standards and guidelines are designed to reduce and mitigate adverse impacts to wildlife. Examples of forestwide direction include maintaining minimum levels of old growth habitat, snags, and coarse woody debris.

Improvement in elk security habitat would likely be most difficult under Alternatives E and A, due to the likely increase in road densities necessary to accomplish timber harvest objectives and public resistance to road closures or the effectiveness of the closures. Potentials for additional road construction would be least in Alternative C followed by B, D-DEIS, and D-FEIS.

There has been concern that the road construction and timber harvest activities conducted on the Forest have occurred in the best or most productive wildlife habitats, as described by gentler slopes and more productive soils, described previously. While some disturbances are short term, such as regeneration of stands, disturbances from roads or landing sites carry a longer term impact to wildlife habitat. To summarize these potential effects, the table below shows the amount of tentatively suited forested lands, comprised of gentler slopes and good soils, and the portion of those areas designated as suited by alternative, which is a function of the management prescription allocations and forestwide standards and guidelines. Potential adverse impacts from timber management, based on harvest levels from most to least by alternative are E, A, D-DEIS, D-FEIS, B, and C. While harvest quantities may fluctuate according to budget and other factors, the suited acres offer a more steady comparison among alternatives. Previously, suited acres under the 1985 Plan (and as analyzed in the 1994 ASQ amendment) were approximately 262,000 acres. The benefit of achieving a more diverse habitat structure in terms of age classes through mechanical harvest would be greatest with

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the alternatives that have more suited acres, however natural disturbances would continue to be the driving factor on age class diversity. Conversely, those alternatives with the greatest area designated suited for timber harvest could result in the least area of old forest over the short-term.

Table 3-84. Suited and tentatively suited acres by alternative describing effects to wildlife habitat.

	Alt. E	Alt. A	Alt. D-FEIS	Alt. D-DEIS	Alt.B	Alt. C
Suited Acres	307,901	262,359	185,277	175,070	117,756	57,323
Tentatively Suited Acres	347,519	347,519	347,519	347,519	347,519	347,519
Forested Acres	727,240	727,240	727,240	727,240	727,240	727,240

The following table presents a synopsis of the cumulative effects of plan alternatives for this general summary of wildlife, including demand species.

Table 3-85. Relative impact of alternatives on wildlife.

Land Use Category	Less Impact← Relative Impact →More Impact to wildlife					
Effects from land authorizations	No difference between alternatives					
Effects from motorized recreation mgmt. (potential for user created roads and increased dispersed recreation use associated with anticipated road construction)	C	D-FEIS	B	D-DEIS	A	E
Effects from livestock grazing	No difference between alternatives					
Effects from timber harvesting (potential for increased loss of habitat due to road construction)	C	B	D-DEIS	D-FEIS	A	E
Effects from utility corridors and additional development of land	No difference between alternatives					
Land available for locatable minerals and oil and gas	C	B	D-DEIS	D-FEIS	A	E

Uses and Designations of the Forest

Lands

Introduction

This section addresses those aspects of Forest Service management relating to land ownership, special uses (e.g., communications sites, utility corridors), and rights-of-ways. The Revised Bighorn National Forest Land and Resource Management Plan (Revised Plan) provides for a variety of special uses across all alternatives, and current major uses are continued through all alternatives.

Demand for the use and occupancy of the Forest continues to grow, with accompanying challenges to permit administration. Use and occupancy of National Forest System lands may be authorized when such use is determined to be in the public interest. Use and occupancy for both non-recreational activities, as well as certain recreational activities, is approved through the issuance of special use authorizations. Recreation special uses are discussed in the Recreation section of this chapter.

Legal and Administrative Framework

Act of 1866 General Mining Law authorizes rights-of-way across public lands for ditches and roads.

Alaska National Interest Lands Conservation Act, 1980 provides direction for providing access to non-federally owned land within the boundaries of the Forest.

An Act to Repeal Timber-Culture Laws, 1891 authorizes ditch easements across public lands and Forest Reserves.

Organic Act of 1897 provides for rules to regulate occupancy and use of the Forest Reserves.

General Exchange Act of 1922 authorizes land adjustments within Forest boundaries.

Federal Land Policy and Management Act of 1976 updated authority for management of National Forest lands, provided general authority for use and occupancy of Forest lands, required fair market value for uses on the Forest, and repealed sections of many previous acts.

Water Conveyance Act of 1986 amended FLMPA to authorize permanent easements for agricultural water systems.

Occupancy Permits Act (March 4, 1915) authorizes use and occupancy of National Forest land for recreation purposes including resorts and recreation residences.

AFFECTED ENVIRONMENT

Land Ownership

Amount of land ownership within the Forest is shown in the following table.

Table 3-86. Land ownership on the Bighorn National Forest.

Land Ownership	Acres
National Forest System (NFS)	1,104,978
Other (non-NFS)	7,450
Total	1,112,429

Land Ownership Adjustments, Rights-of-Way, and Access

There are limited opportunities for land ownership adjustments on the Forest due to the consolidated nature of the National Forest System lands (limited inholdings). Only a few fragmented non-federal parcels exist within the Forest boundary. Two of these parcels are for reservoir use. Over the past 15 years, the Forest has used purchases, exchanges, donations, and Small Tract Act sales to improve land ownership patterns.

Most funding for future acquisition would come from the Land and Water Conservation Fund. This is a competitive national fund and is not a reliable source of funding for land purchases on the Forest. In the future, it is expected that most adjustments will be done with land exchanges.

The Forest utilizes the Small Tracts Act (Pub L. 97-465) to resolve land disputes and management problems by conveying through sale, exchange or interchange, three categories of tracts of land: parcels encroached upon, road rights-of-ways, and mineral survey fractions. All applications must qualify under the guidelines of the Small Tracts Act.

Particularly on the east side of the Forest, lack of public access to the Forest is an ongoing and growing problem as public demands to use the Forest increase. Some private landowners adjacent to Forest boundaries may enjoy nearly exclusive use of nearby National Forest lands through control of public access through their property. Some landowners are reluctant to allow public access and in some cases have been unwilling to negotiate rights-of-way across their property.

According to the Social Assessment of the Four-County Area, there was a marked variance in opinion among residents of the four counties with regard to providing more roads for access. Out of 14 desired future condition issues, this issue ranked in priority from 6th (Washakie County) to 14th (Sheridan County) with Johnson (12th) and Big Horn Counties (7th) situated in between. As a whole, this issue was ranked 10th out of 14 issues, with a ranking of “1” being the highest priority (State of Wyoming, 2002).

The Forest has acquired one right-of-way for road access since 1990, achieved through the landownership adjustment program. In 1990, the Forest identified 10-15 priority cases needed to further provide access to the Forest. Further complicating the issue is the fact that when land changes ownership, it is often subdivided, making access negotiations more difficult since more landowners are involved.

Special Uses

Special use authorizations authorize the occupancy and use of National Forest System lands by federal, state, and local agencies; private industry; and individuals. Several different public laws regulate activities under special use authorizations. The Organic Act of 1897 and the Federal Land and Policy Management Act (FLPMA) of 1976 authorize the majority of the uses. The Occupancy Permits Act of March 4, 1915 authorizes use and occupancy of National Forest land.

Applications for lands-related special uses are increasing as more people desire to make use of National Forest lands. Demand for the use and occupancy of the Forest continues to grow, making permit issuance and administration a challenge as Forest staff review and process new authorizations for many uses every year. As of June 2005, there were 144 non-recreational special uses authorized (see following table). Grazing permits are addressed in the Livestock Grazing section of this chapter.

Table 3-87. Number of special use permits on the Bighorn National Forest as of June 2005.

Special Uses	Number of Permits
Powerlines	4
Road easements/permits	11
Ditches - irrigation	7
Communication leases	21
Dams / reservoirs	11
Water conveyance easements	11
Pastures/corrals	11
Fish hatchery	1
Telephone lines	5
Gravel pits	2
Water pipelines/spring developments	8
Fences	5

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Special Uses	Number of Permits
Agricultural residence	5
Roadside chapel	1
Wildlife water supply	2
Research area	4
Construction camps	5
Hydroelectric / FERC exempt	1
DOT easements	8
FRTA easements	3
Stream gauging stations	2
Stockwater	1
Weirs/water diversions	5
Monument	1
Sign	1
Resource monitoring site	3
Batch and mixing project	1
Stockpile site	3
Geologic exploration	1
Total	144

Source: SUDS (Special Use Data System)

Utility Corridors

There is one proposed non-priority utility corridor on the Forest, designated in the 1992 Western Regional Corridor Study by the Western Utility Group (WUG). This corridor follows Highway 14 and is not classified as a priority corridor in the 2002 Priority Corridor Designation (WUG 2002). Given that it is a non-priority utility corridor, it would be addressed through the standard permitting process at a later time if a project were proposed within the corridor. No priority corridors are located within the Forest. The Forest only designates corridors for transmission lines over 69 kilovolts and for pipelines more than 10 inches in diameter. Local distribution lines and smaller pipelines have not been identified as corridors and are normally located in conjunction with an existing road system or other previously disturbed areas, in order to minimize environmental impacts.

Designated Communication Sites

Communication sites are identified in the following table. Any additional sites for commercial or Forest Service use will require approval through the National Environmental Policy Act process and designation by the Regional Forester.

Table 3-88. Bighorn National Forest communication sites.

Site	Used by Forest Service	# Communication Leases/Permits
Medicine Mountain	Yes	8
Dome Peak	No	1
Bosin Rock	No	6
Little Goose Peak	No	1
Meadowlark	Yes	3
Pole Mountain	No	0
Hunter Mesa	Yes	1

Source: SUDS.

Note: Leases are issued to building owners who may rent space to other users.

ENVIRONMENTAL CONSEQUENCES

General Effects

Across all alternatives, the issuance and administration of special use authorizations will continue to provide for a variety of recreation and non-recreation activities on the Forest.

Land Adjustments and Acquired Rights-of-Way

There are approximately 7,450 acres of non-federal lands located within the boundary of the Forest. The Forest's land exchange program is very limited, as a direct result of the way the Forest itself is situated – very little private acreage exists within the boundaries of the Forest.

The amount of potential and opportunity for land exchanges is not expected to vary by alternative. Across all alternatives, through cooperation with other landowners, the Forest will emphasize improved landownership and access patterns that benefit both private landowners and the public.

As per a forestwide standard, the Forest will prohibit motorized access from private land where access for the general public is not available, except by special authorization.

The opportunities for rights-of-way acquisition do not change by alternative. The Forest rights-of-way inventory identified more than a dozen roads and/or trails that need to be acquired in order to provide improved access to the Forest. However, the most readily obtainable rights-of-way have already been acquired, and remaining rights-of-ways needed are more complex.

Utility Corridors

There are no utility corridors crossing the Forest, although there is one proposed utility corridor which would follow U.S. Highway 14 across the Forest (if implemented). This corridor would not be affected by (nor would it affect) the Wild and Scenic River recommendation of the Tongue River as put forth in Alternatives A, B, C and D-FEIS since it is not located adjacent to the recommended segment of the Tongue River.

Under all alternatives, new or replacement powerlines will be designed to reduce the risk of electrocution to raptors. Also consistent across all alternatives, relocation, reconstruction or new electrical utility lines of 33 kilovolts or less and telephone lines will be buried unless it is not technically feasible. Existing electrical utility lines of 33 kilovolts or less will be buried at the earliest opportunity as determined by the District Ranger.

Communication sites

The number of communication sites does not change by alternative. Any additional sites for public use will require designation after site-specific NEPA analysis and approval by the Regional Forester.

Cumulative Effects

The cumulative effects table at the beginning of this chapter includes a list of past, present, and reasonably foreseeable future activities that were considered with regard to cumulative effects. The next 15 years are considered the time span for reasonably foreseeable future cumulative effects. The area of consideration is the Bighorn National Forest and adjoining lands within the four-county area.

The Forest has gained access to one right-of-way for a road since 1990, achieved through the landownership adjustment program. In 1990, the Forest identified 10-15 priority cases needed to further provide access to the Forest.

In terms of past actions, in 2004 the Forest completed an approximately 100-acre land exchange proposal involving the City of Buffalo, Tie Hack reservoir and land on a nearby National Forest.

There are no anticipated reasonably foreseeable future actions specific to a particular alternative that would differ from any of the other alternatives, for communication sites, utility corridors, or land adjustments and rights-of-way acquisition.

Recreation

Introduction

America's National Forests provide a diversity of outdoor recreation opportunities on over 191 million acres of public lands. As the largest provider of outdoor recreation in the country, the National Forests received over 850 million visits in 1996. National Forests provide a wide spectrum of outdoor recreation opportunities, from the more developed to the most primitive, primarily in a forested setting.

The Bighorn National Forest is located in the Big Horn Mountains of north central Wyoming. It is an isolated mountain range situated between the Black Hills range to the east and the main range of the Rocky Mountains to the west and shares a border with the state of Montana. Interstates 25 and 90 and U.S. Highways 14, 14A, and 16 channel traffic around and through the Forest.

Market Area

Market area for the Bighorn National Forest can be defined on both a local and national scale. Locally, the market area for the Bighorn National Forest primarily consists of users from the 4-county area - Big Horn, Johnson, Sheridan, and Washakie Counties. The secondary market consists primarily of a subregional influx of visitors from within several hundred miles of the Forest (e.g., Casper, Gillette, Billings, MT and Rapid City, SD). On a national level, the Bighorn National Forest receives visitors from a much wider geographic area, with a marked tendency towards the Midwest (ND, SD, MN, WI, MI).

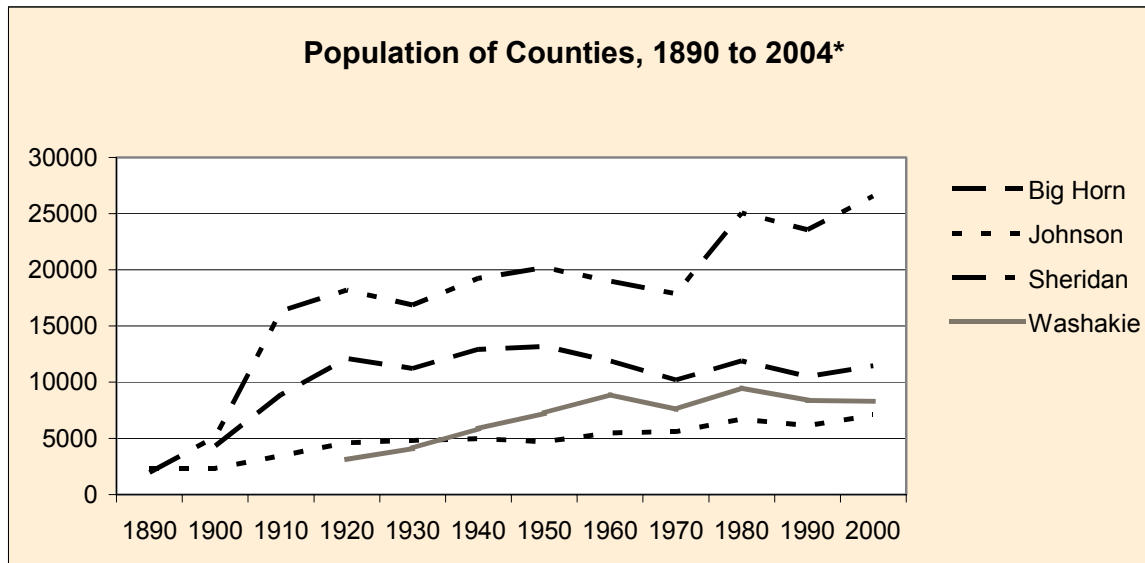
According to the 1998 Scenic Corridor Management Plan, most users of the Forest in the spring and early summer are residents of the four-county area. As the summer progresses, visitation by local and non-local users increase, but visits by travelers from outside the area increase at a faster rate. Use is highest during the four weeks between July 15 and August 15, when many of the campgrounds are full. By late August, visits by families, especially non-local families, taper off. Local users are the predominant visitors to the Forest in the late summer and early fall, citing less crowded conditions and hunting season as reasons for coming. Winter use, particularly with regard to snowmobiling, sees a return of a higher proportion of nonlocal users, especially from the Midwest, although local users still remain active recreators on the Forest throughout the winter.

Local Population Trends

Big Horn, Johnson, Sheridan, and Washakie counties contain the entirety of the Bighorn National Forest, totaling 53,435 people in 2001. The population shifts for the four counties have been quite volatile over the past fifty years. On the west side, the ever-changing market for sugar beets along with substantial shifts in minerals, account for some of the

fluctuation. On the east side, a downward slide in agriculture has had some impact on population figures, but much of the volatility is due to changes in energy production such as the coal boom in the 1970s for Sheridan and coalbed methane gas production in the late 1990s for Sheridan and Johnson counties.

Figure 3-1. Area county population trends.



*1890 – 2000 is based on US Census Bureau data. 2004 is based on U.S. Census Bureau Population Estimates Program

Recreation in America's National Forests

Recreation participation has grown, and continues to grow with the expanding population. Survey results from the National Survey on Recreation and the Environment (NSRE) estimate that “98.5 percent of Americans 16 years of age or older participated in at some type of outdoor recreation in the 12 months prior to being interviewed, which means that almost 210 million people age 16 or older are involved in some form of outdoor recreation.” (Cordell, 2002).

National Recreation Agenda

In response to the growing importance of the National Forests for recreation, the Forest Service, in the spring of 2001, finalized a Recreation Agenda meant to direct recreation management on National Forests into the Agency's second millennium. As stated in the Agenda:

“Both our deteriorating infrastructure and our recreation visitors are demanding more attention. This agenda focuses on meeting as much of this demand as possible within ecological and social limits...” including “impacts on the resource, impacts on experiences of other visitors, and limits on the recreation infrastructure... The realities of diverse interests, finite budgets, and environmental considerations will each influence the choices

to be made in the management of forest and grassland resources” (USDA Forest Service 2000a).

The Agenda includes direction for Forest managers, some of which are included below:

- ◆ Invest in some facilities to meet health, sanitation, and accessibility standards, and at the same time, remove those that no longer meet our needs, are out of tune with the natural setting, present significant health and safety problems, and are too expensive to maintain.
- ◆ Manage OHV use to assure high quality motorized opportunities and quality experiences, while maintaining acceptable and balanced environmental impacts on trails, and understanding that some settings are inappropriate for this use.
- ◆ Provide access to recreation opportunities, including securing rights-of-way, and incorporating universal design in our facilities.

Unmanaged Recreation – A “Chief’s Threat”

In the summer of 2003, Forest Service Chief Dale Bosworth outlined the four primary threats facing the National Forests and Grasslands. One of the four threats was unmanaged recreation. Following are excerpts from his July 17, 2003 speech to the 81st Annual Izaak Walton Convention (Bosworth 2003):

“Back when we had light recreational use, we didn't need to manage it so much; but now that it's heavier, we do. There are still uses like blueberry picking that we don't need to manage much. But if every blueberry was picked, we would need to manage it more. At one time, we didn't need to manage mushroom picking much, but now we do in some areas.

“...OHVs are a great way to experience the outdoors, and only a tiny fraction of the users leave lasting traces by going cross-country. But the number of OHV users has just exploded in recent years. Even a tiny percentage of impact from all those millions of OHV users is still a lot of impact.

“...Each year, the national forests and grasslands get hundreds of miles of unauthorized roads and trails due to repeated cross-country use. We're seeing more and more erosion, water degradation, and habitat destruction. We're seeing more and more conflicts between users.”

Bighorn National Forest Major Recreation Issues

Issues and management concerns related to recreation on the Bighorn National Forest have increased substantially since the 1985 Plan. These issues were highlighted as a result of numerous public meetings as well as written comments that the Forest received. In summary, the predominant issues related to recreation on the Bighorn National Forest are:

- ◆ Motorized users seek additional opportunities while other visitors participating in non-motorized recreation activities demand additional areas free from the sights and sounds of motorized recreation.

- ◆ Since 1985, changes in technology have introduced new recreational activities or have expanded recreational opportunities (e.g., ATVs and enhanced capabilities of modern snowmobiles, etc) which have in some cases resulted in increased conflict with existing users.
- ◆ As use increases, resource impacts associated with many recreational activities are on the rise, including damage to riparian environments and vegetation in heavily used areas, recreational stock damage, soil compaction, and widening and pioneering of new travel routes, and improper disposal of litter, and human waste.
- ◆ Winter sports, snowmobiling in particular, are more popular than originally anticipated, extending the visitor season. There was some demand shown for nonmotorized winter recreation areas which are more easily accessible than the Cloud Peak Wilderness.

Other Recreation Opportunities Provided by Public Agencies

To grasp the recreation niche that the Bighorn National Forest provides, a comparison with the recreation offerings provided by other public entities is helpful. Wyoming is 49% federally owned. Federal public land management agencies include the National Park Service, the Bureau of Land Management, the Bureau of Reclamation, and the Forest Service. The management niches provided by these agencies complement one another by serving a broad spectrum of recreation enthusiasts and responding to a diverse range of local, regional, and national needs.

The Bureau of Land Management (BLM) in Wyoming manages over 18 million surface acres of public land and an additional 23 million subsurface acres of mineral estate, including National Forest acres. The agency primarily focuses on providing undeveloped recreation opportunities such as fishing, four-wheeling, sightseeing, river floating, hiking and hunting. Unless otherwise posted, all public lands are available for recreation use.

Established in 1902, the Bureau of Reclamation is best known for the dams, powerplants, and canals it constructed in the 17 western states. The Wyoming Area Office of the Bureau of Reclamation manages 20 reservoirs and 19 dams in the state, although the agency manages recreation facilities (boat launches, etc.) at some of these sites in partnership with either the BLM or state and local government.

The state parks in Wyoming are premier providers of flat water recreation, working in partnership with the Bureau of Reclamation at some sites. These facilities provide opportunities not available in the higher altitudes of the Forest. Wyoming State Parks also manage the state's historic sites, providing a valuable interpretive complement to recreational opportunities in the state. The Wyoming Game and Fish Department provides public access areas for numerous outdoor recreation opportunities (primarily focused around fish- and wildlife-based activities) along with "an adequate and flexible system for the control, management, protection, and regulation of all Wyoming wildlife" as defined in W.S. 23-1-103.

The Bighorn National Forest's Recreational “Niche”

The Bighorn National Forest, as part of the regional and national network of National Forests, provides a complimentary offering of recreation opportunities to many of those listed above. The predominant recreational niche of the Bighorn National Forest encompasses undeveloped settings available to dispersed recreationists as well as built environments such as campgrounds and visitor centers which primarily emphasize the scenic byway corridors (USDA Forest Service, 2003).

Some features that are particularly distinctive to the Bighorn National Forest when compared to other National Forests in the area include:

- ◆ The Forest's easily accessible terrain for winter and summer motorized travel (due to its numerous open parks set within a predominantly rolling terrain) which creates both opportunities and challenges for management.
- ◆ Numerous opportunities for interpretation of nationally significant cultural phenomena from the last vintage of free-roaming Plains Indian groups.
- ◆ Easily-accessible high-elevation recreation areas in a location that allows for easy access by a multi-state clientele, including some of the first granitic mountain peaks that are encountered by travelers heading west in this part of the country.
- ◆ In addition, the Forest serves as a draw for many recreationists who wish to experience a primitive setting without the likelihood of encountering grizzly bear, found on other nearby forests in western Wyoming and Montana.

Legal and Administrative Framework

Department of Agriculture Organic Act of 1862 (7 U.S.C. 2201).

The Multiple-Use Sustained-Yield Act of 1960 (74 Stat 215; 16 U.S.C. 528).

The Wilderness Act of September 3, 1964 (78 Stat 890; 16 U.S.C. 1121).

The Land and Water Conservation Fund Act (September 3, 1964) (16 U.S.C. 4601-4).

Architectural Barriers Act of 1968 (August 12, 1968).

National Trails System Act of 1968 (October 2, 1968).

Forest and Rangeland Renewable Resources Act of 1978 (16 U.S.C. 1600).

Americans with Disabilities Act of 1990 (July 26, 1990).

National Trails System Act of Oct. 1968

National Forest Roads and Trails Act

Numerous Executive Orders

Resource Protection Measures

Mitigation measures to reduce or prevent significant effects of developed and dispersed recreation on the resource, as well as protection of recreation opportunities during project-level planning, are outlined in the standards and guidelines for recreation and other resource activities. Impacts to the recreation resource itself through management actions can be addressed by manipulation of site-specific factors at the project level, which involve a level of detail not associated with forest plan revision.

AFFECTED ENVIRONMENT

Introduction

The Big Horns are a popular travel-through route between the Black Hills National Forest and Yellowstone National Park. In 1985, there were 2,226,159 visitors to Yellowstone, increasing to 2,838,233 visitors in 2000. This represents an increase of 27% or an average of 1.8% annually, although use has fluctuated during the past fifteen years.

In 1990, all three major highways crossing the forest (U.S. Highway 14 – Bighorn Scenic Byway, U.S. Highway 14A – Medicine Wheel Passage, and U.S. Highway 16 – Cloud Peak Skyway) were designated as National Scenic Byways.

Prior to the 1960s, management of recreation activities and opportunities on the Bighorn National Forest was largely custodial in nature. As recreation use increased, the Forest assumed a more active management role.

National Visitor Use Monitoring Survey Results

Historically, the Forest Service has reported visitation not in terms of direct numbers of people who come to the Forest, but in terms of a Recreation Visitor Day (RVD) which is defined as any recreational use on Forest sites which results in 12 visitor hours. For the Final Environmental Impact Statement (FEIS), the Forest, in consultation with specialists at the Regional Office and the University of Wyoming, used National Visitor Use Monitoring (NVUM) data for use estimates and projections. The NVUM survey is more credible, from a use statistics standpoint, compared to the old Forest methodology used for the Draft Environmental Impact Statement (DEIS).

Between October 2000 and September 2001, the National Visitor Use Monitoring Survey was conducted on the Bighorn National Forest. The results of the survey were made available to the Forest in August 2002. Some survey findings are discussed in the following paragraphs.

The average length of stay for recreation visitors was 16.4 hours, with visitors going to an average of 1.3 sites (e.g., campsites, picnic areas, trails, interpretive centers, resorts, etc.) during their visit. The average length of stay in the Cloud Peak Wilderness was 35.4 hours. Twenty three percent of visitors stayed overnight. Average length of stay at developed sites was 1.4 hours.

In working with the Southern Research Station of the U.S. Forest Service in May 2005, Bighorn NVUM data was analyzed based on visitor origin. Fifty-seven percent of visitors during the reporting period were Wyoming residents from within the local area, 17% were Wyoming residents from outside of the local area, and 26% were nonresidents (English 2004):

Basic descriptors of Forest visitors were also gathered. Males accounted for 62% of visitors, with females accounting for 38%. A high percentage (73%) of visitors were between 21 and 60 years of age, with the most visitors being between the ages of 41 and 50 years of age. Visitors categorized themselves into one of five race/ethnicity categories, the top four categories being 97.6% being white, 0.4% Spanish, Hispanic or Latino, 0.3% were American Indian/Alaskan native, and 0.1% were Asian.

According to the NVUM survey, the key factors of importance to both local and nonlocal visitors with regard to the quality of their recreation experience was (in order of preference): scenery, condition of the natural environment, attractiveness of the Forest landscape, and available parking/condition of Forest roads/adequate signage.

It is worthwhile to contrast the priorities placed by visitors to the Bighorn from a national scale with those of local users. In 2000, the Bighorn National Forest Social Assessment surveyed residents of the hour-county area in an attempt to obtain relevant social information. One of the results of this survey was a ranking of public benefits provided by the Bighorn National Forest:

- | | |
|-------------------------------------|---------------|
| 1. Water | 6. Recreation |
| 2. Future use | 7. Timber |
| 3. Wildlife | 8. Grazing |
| 4. A place to relax | 9. Minerals |
| 5. Support traditional ways of life | |

One important component of the NVUM survey was “perception of crowding.” Visitors were asked to rate their perception of how crowded the recreation site or area felt to them. This information is useful when looking at the type of site the visitor was using. For example, someone visiting a designated wilderness may think 5 people is too many while someone visiting a developed campground may think 200 people is about right. The table below shows perception of crowding by site type on a scale of 1 to 10 where 1 means hardly anyone was there and a 10 means the area was perceived as overcrowded (general forest areas are those sites which are outside of day use/overnight developed sites or wilderness).

Table 3-89. Average perception of crowding by Bighorn National Forest recreation visitors by site type.

Overnight Developed Sites	Day Use Developed Sites	Wilderness	General Forest Areas
5.2	2.9	4.0	5.59

1 = "hardly anyone was there", 10 = the area was perceived as overcrowded

This shows that, in general, there is not a prevailing perception of overcrowding among visitors to the Bighorn National Forest.

Recreation-related Expenditures

Outdoor recreation expenditures contribute significantly to Wyoming's economy. Tourism in Wyoming is the second largest industry behind minerals. The NVUM for the Bighorn National Forest determined that in a typical year, visitors to the Bighorn National Forest spent an average of \$2341.80 on all outdoor recreation activities, including equipment, recreation trips, memberships and licenses (USDA Forest Service, August 2001). This is a total annual expenditure amount and likely

The economic section of this FEIS discusses in greater detail, within a 2001-2010 timespan, the economic benefit of Bighorn National Forest recreation specific to tourism (i.e. from visitors outside of the four-county area).

Recreation Supply

Recreation Settings

Some people desire an emphasis on undeveloped, remote recreation settings, while other people want a mix of developed and undeveloped settings and yet others are interested in seeing more developed settings and easier access. The resource manager's goal is to provide an appropriate mix of recreation settings or recreation opportunities, as appropriate, for obtaining each of these experiences.

The Forest Service uses the Recreation Opportunity Spectrum (ROS) to describe different recreation experiences using the setting, activities, and the experience. These experiences are categorized into ROS classes.

In 1992, the Forest updated the original 1979 ROS inventory used in the 1985 Forest Plan. The new inventory included differences based on new road development, new timber sales and other facility construction, management area prescriptions that dictate specific ROS classes, refinement of the Wilderness boundaries, and the incorporation of the "Roaded Modified" subclass of "Roaded Natural." In 1998, the 1992 map was updated in anticipation of forest plan revision.

The following ROS classes and acres have been identified on the Bighorn National Forest:

Primitive (P)

181,232 acres (16%); 137,707 wilderness acres and 43,525 non-wilderness acres

These areas are primarily unmodified with a very high probability of experiencing solitude, freedom, closeness to nature, tranquility, self-reliance, challenge, and risk. There is a low likelihood of encountering other users. Access and travel is nonmotorized on trails or cross country. These areas are generally at least 5,000 acres in size and at least 3 miles away from all roads or trails with motorized use (or they have sufficient spatial or topographic characteristics to allow a sense of solitude).

Semi-Primitive Nonmotorized (SPNM)

278,108 acres (25%); 54,189 acres wilderness and 223,919 non-wilderness acres

Acres in a semi-primitive nonmotorized class are in a natural appearing environment with a high probability of experiencing solitude, challenge, and risk. There is a low probability of encountering other users, but there may be evidence of other users. Access and travel is nonmotorized on trails, some primitive roads or cross-country. These areas are generally at least 2,500 acres in size and are between ½ and 3 miles from all roads or trails with motorized use.

Semi-Primitive Motorized (SPM)

372,549 acres (33%); all non-wilderness acres

The setting is in a predominantly natural appearing with two-track roads and/or motorized trails. These areas provide for a more solitary experience with a high degree of challenge and risk in using motorized equipment. There is a low concentration of users, but often evidence of others on trails. These areas are generally at least 2,500 acres in size and are at least ½ mile from a better than primitive road.

Roaded Modified (RM)

106,532 acres (10%); all non-wilderness acres

This is a sub-class of the Roaded Natural class and was not used in the 1985 Plan. These areas are located where concentrations of roads occur due to past timber harvest. The environment is substantially modified except for campsites. Roads, landings, slash and debris may be strongly dominant from within yet remain less noticeable from distant sensitive roads and highways. There is opportunity to get away from others, but with easy access. There is some self-reliance in building own campsite and use of motorized equipment, but little challenge and risk. There is moderate evidence of other users on roads and little evidence of others or interaction at campsites. Conventional motorized access includes sedans, trailers, ATVs and motorcycle travel.

Roaded Natural (RN)

140,393 acres (13%); all non-wilderness acres

The environment is mostly natural appearing, as viewed from sensitive roads and trails. These areas are mainly found around developed sites where the forested environment is managed to meet the needs of the visitor and are often within ½ of a better than primitive road. They provide scenic driving opportunities, trailheads, dispersed campsites, and wildlife viewing, fishing, and hunting areas. Access and travel is motorized including passenger cars, trucks, RVs and some motorhomes.

Rural (R)

32,544 acres (3%); all non-wilderness acres

This class provides highly developed opportunities, specifically along the scenic byways (U.S. Highway 14, U.S. Highway 14A, U.S. Highway 16). Use levels are high, development of facilities provides for greater numbers of visitors than other areas on the Forest, management is more obvious, and visitors can expect opportunities to interact with others.

General Recreation Use Trends

The concept of demand represents what could occur in the way of future Forest visitation. It portrays the desires of the public for recreation opportunities. *Demand* is not necessarily the same as *use*, which is generally thought of as what actually occurs if demand is satisfied. In other words, use is influenced by available supply or capacity. For example, a campground may accommodate 50 people because of its design limitations. If it were full with campers, its use would be recorded as 50. However, if 100 people wanted to camp, but only 50 could, the demand for that particular recreation would instead be recorded as 100.

The 4-county area that includes the Bighorn National Forest has experienced some significant fluctuations in population over the past 25 years, due to booms in oil and gas production, among other things. Population forecasts for the period of 2000 – 2010 predict further steady increases (State of Wyoming 2005), although at a much slower pace on the west side (Big Horn and Washakie counties) than on the east side (Sheridan and Johnson counties). The current development associated with coalbed methane activities may further contribute to population growth and is further discussed in the cumulative effects section. Given the contribution of visitation from the local area, it is likely that as local populations increase, Forest visitation will increase as well.

Other influences include trends that are occurring in terms of visitations to other regional attractions that require them to pass through the Bighorn National Forest on their way to other destinations. All Wyoming, South Dakota, and Montana destinations that summer visitors cited as their primary destination expect to experience increased use over the next ten years.

National trends in outdoor recreation also have the potential to affect Forest visitation. Recreational use of national forests and grasslands has been increasing for decades, and is

expected to continue to increase. The most popular activities at the national level are walking, nonconsumptive wildlife activities (birdwatching, etc.), biking, sightseeing, non-pool swimming, fishing, family gatherings, and picnicking. The five fastest-growing outdoor recreation activities at the national level through the year 2050 are projected to be: visiting historic places, downhill skiing, snowmobiling, sightseeing, and participating in nonconsumptive wildlife activities.

In comparison to the national statistics on most popular recreation activities, the NVUM results found that the top five recreation activities reported by the visitors to the Bighorn National Forest during the period of October 2000 through September 2001 were viewing natural features, viewing wildlife, relaxing, hiking/walking, and driving for pleasure.

The FEIS analysis used projections based on NVUM visitation levels applied to local population growth rates (for visitation by residents of the four-county area) or growth rate projections to 2010 (for visitation by nonresidents and state residents outside the four-county area) (Bowker et al. 1999). Variance applied to alternatives A and E are discussed in the environmental consequences section.

Table 3-90. Bighorn National Forest total primary activity visits.

All Activities – Primary Activity Visits				
Year	Resident 4-county area	Resident outside 4-county area	Nonresident	Total
2001 base year (NVUM)	414,100	126,900	190,000	731,000
2010 projection	443,483	132,339	200,705	776,527
% increase	+7.1%	+4.3%	+5.6%	+6.2%

Source: Bighorn NVUM data, State of Wyoming, and Bowker et al. (1999)

Growth in visitation from local residents will increase slightly faster than the other categories, based primarily on the state of Wyoming's population growth projections.

In 1998, a Scenic Byway Corridor Management Plan was completed. The plan asked both general visitors and campground users whether or not they had experienced crowding while engaged in any activities on the Bighorn National Forest. Of those responding, 70% indicated "no" and 27% indicated "yes." The areas most frequently identified by those who indicated they had experienced crowding were the following: Sibley Lake (9 responses), "campgrounds (6), "everywhere" (4), Sitting Bull campground (2) and Medicine Wheel (2) (Edaw, Inc. 1998)

Developed Recreation Supply

Developed recreation opportunities are located primarily along major travelways. They include developed campgrounds, picnic areas, resorts, visitor centers, interpretive sites, recreation residences (under special use permit), boat landings, and organizational camps.

There are 89 developed sites on the Forest totaling 6,191 PAOTs (persons at one time capacity), with a season site capacity of 842,542 PAOT days. The following table displays developed recreation capacities in greater detail.

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Table 3-91. Developed site capacities.

Developed Site Type	Total # of Sites	Total PAOTs	Season-long Capacity (PAOTs)
Campgrounds (504 campsites total)	37	2,520	264,360
Picnic Grounds	16	925	113,190
Trailheads	11	949	136,234
Warming Huts/Nordic Parking Areas	5	102	27,463
Interpretive Sites	10	1,295	226,695
Other Sites (boat landings, RV dumps, etc)	11	400	74,600
Subtotal	89	6,191	842,542
Developed sites under special use permit	281	3,147	822,224
Total Sites	370	9,338	1,664,766

Individuals operate 281 sites under special use permits within the Forest, primarily including two downhill ski areas, 265 recreation residences, 10 resort permits and 3 organization camp permits. These areas have a total site capacity of 3,147 PAOTs and a season capacity of 822,224 PAOT days (see the Recreation Special Uses section for additional information). Combined, there is a total of 370 sites, 9,338 PAOTs, and a season capacity of 1,664,766 PAOT days.

Due to fiscal constraints, very few new developed recreation sites have been built since the mid-1960s, and it is likely that this trend will continue. Beginning in 1993, the Forest upgraded several of the facilities to better accommodate modern recreational vehicles, although more upgrades are still needed. A significant determining factor as to whether or not a campsite can accommodate today's larger RVs and trailers is spur length. A reasonable spur length that can accommodate the majority of today's modern RVs is 50 feet. Slightly more than one third of the Bighorn National Forest's campsites are able to accommodate a large, modern RV based on a minimum necessary spur length of 50 feet.

All but four campgrounds are managed through a concessionaire program. The season is generally from May to September with many campgrounds open only during a portion of May and September.

Major interpretive experiences are available at three sites: Burgess Visitor Center on US Highway 14, Shell Falls Visitor Center on U.S. Highway 14, and Medicine Wheel National Historic Landmark on U.S. Highway 14A. Preparations are underway for the redesign of Shell Falls to improve access and amenities, but no increase in capacity is feasible given the constraints posed by the fact that the facility is located between a U.S. Highway and a canyon. The Medicine Wheel parking site was recently redesigned, although concerns related to recreation capacity at the Medicine Wheel site are subordinate to the Forest's Medicine Wheel Historic Preservation Plan, signed in 1996, which directed that this area

be managed in a manner which protects the integrity of the site as a sacred site and a nationally important traditional cultural property (USDA Forest Service 1996).

Table 3-92. Major interpretive site capacities.

Site	Yearly Operating Days	Capacity - PAOTs	Season-long cap PAOTs
Burgess	147	605	88,935
Shell Falls	179	250	44,750
Medicine Wheel	153	80	12,240
Total	479	935	145,925

Trailheads are discussed in the dispersed recreation section under “trails.”

Developed Recreation Demand and Trends

Demand for developed recreation opportunities is expected to continue to rise. As discussed earlier in this section, for the Final EIS, developed recreation projections have been revised and are based on NVUM visitation levels. Variance applied to Alternatives A and E are discussed in the Environmental Consequences section. Developed camping projections are shown in the following table.

Table 3-93. Developed camping visitation.

Year	Developed Camping Primary Activity Visits	
	2001	2010
# of primary visits	12,128	13,042
% change	--	+7.5%

Source: Bighorn NVUM data, State of Wyoming, and Bowker et al (1999)

Based on concessionaire records for 2002, campground usage rates amounted to 26.5% of forestwide theoretical PAOT capacity. In 2003, it increased slightly to 27.3% of forestwide theoretical PAOT capacity. While this does not exceed a theoretical campground capacity of 40% of maximum, this is a season-long average and includes times of the year when campground demand is lower since use fluctuates depending on the month.

To get a better overall picture of campground demand, it is useful to look at how many campgrounds are experiencing high levels of use, as well as the timing of the use. The table below illustrates how many campgrounds, by month, experience average occupancy rates higher than 40% of theoretical capacity.

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Table 3-94. Bighorn National Forest campgrounds with high (>40% of theoretical capacity) average monthly occupancy levels (1998-2001).

Month	# Campgrounds	% of campgrounds*
May	3	12%
June	5	20%
July	23	92%
August	19	76%
September	9	36%

* Table includes the 25 concessionaire-run campgrounds only.

The occupancy levels in July and August show there are not enough developed camping opportunities during the short, high use season although this does not appear to be translating into perceptions of overcrowding at this point based on the NVUM survey results described earlier in this section (crowding perception of 5.2 out of 10, with 1 being uncrowded and 10 being overcrowded).

Table 3-95. Bighorn National Forest campgrounds with low (<10% of theoretical capacity) average monthly occupancy levels (1998-2001).

Month	# Campgrounds	% of campgrounds*
May	4	16%
June	3	12%
July	3	12%

* Table includes the 25 concessionaire-run campgrounds only.

As mentioned previously, most of the developed campsites on the Forest were designed prior to the advent of today's larger, modern trailers or RVs. Some have been upgraded as funding has become available. The trend toward large, self-contained camper homes has been a relatively recent phenomenon, which less than half of the campsites on the forest can accommodate. Concessionaire records from the 2002 and 2004 camping seasons show the following:

Table 3-96: 2002, 2004 Campsite use types.

Category	% of 2002 & 2004 campsites occupied
Motorhome	17%
Tent	35%
Trailer	48%

* Table includes the 25 concessionaire-run campgrounds only.

Among the major interpretive sites on the Forest, the Burgess Visitor Center had an average of 55,000 visitors per year (1997-2002) with a 10% increase between 1997 and

2002, although since Burgess is a relatively new facility it is likely that visitor levels are continuing to rise compared to early operational years. Shell Falls had an average of 350,000 visitors per year and that number has remained fairly constant from 1997 to 2002. Medicine Wheel National Historic Landmark had an average of 15,536 visitors per year, remaining fairly constant between 1997 and 2002.

Based on growth trends for developed recreation on the Bighorn National Forest, usage at the Burgess Visitor Center should not exceed capacity during the next planning period. Shell Falls, on a sheer PAOT basis, is already exceeding capacity in theory but expansion of number of parking spots available (which is the primary limiting factor here) is not feasible given the terrain and proximity of the site to the highway, in addition to the fact that the average visitor stays at Shell Falls for a relatively short period. The Medicine Wheel National Historic Landmark is slightly exceeding capacity, although use trend records over the last ten years (1993 - 2003) indicate visitation has stabilized at an acceptable level consistent with the management goals set in the Medicine Wheel Historic Preservation Plan (1996).

Developed Recreation Issues

Developed facilities are a popular component of the Bighorn National Forest's recreational experience. They are also a large investment for the American public, requiring regular maintenance and labor-intensive upkeep. Although the Forest strives to upgrade existing campgrounds, outdated facilities are still commonplace, and deferred maintenance costs accelerate as recreation facilities age. In 2002, estimated deferred maintenance for developed recreation sites exceeded \$2 million on the Forest. This estimate takes into account annual maintenance requirements and capital improvements, as well as accessibility upgrades. Many campgrounds exceed acceptable levels of capacity at various times of the season; unfortunately, the need for additional facilities is overshadowed by a shortfall in maintenance and rehabilitation funds for existing facilities and the high cost of construction around the forest.

Forest facility master planning activities are scheduled to take place in 2007. This effort will analyze developed recreation offerings on the Bighorn National Forest given usage and funding levels, among other aspects. A review of developed recreation sites with low occupancy could be a part of the facility planning review and analysis.

Use by the elderly is likely to increase proportionately faster than other demographic groups given the national aging phenomenon. As visitation increases and the state and national population ages, there is also likely to be an associated increased demand for recreation opportunities on the developed end of the ROS spectrum. Examples of sites on the Forest where demand could increase markedly based on this anticipated trend include easily accessible interpretive sites, visitor information centers, and picnic areas.

Dispersed Recreation Supply

Dispersed recreation includes all those activities that occur outside of developed sites (i.e., campgrounds, picnic areas, visitor centers, etc) and wilderness. Particularly popular dispersed recreation activities include dispersed camping, fishing, hunting, driving for

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pleasure, hiking, horseback travel, all terrain vehicle and motorcycle use, and viewing wildlife.

Many nearby areas off the Forest provide hunting opportunities for deer, antelope, and small game. By comparison, local public opportunities for elk, moose, and lion hunting are found almost entirely on the Forest. Quality fishing opportunities are available in areas off the Forest, but occur in different settings and sometimes for different fish species than those which are found on the Forest.

Several caves are located within the Forest, four of which have been determined significant, as defined and described in the Federal Cave Resources Protection Act, of 1988. One of these caves, Tongue River cave, receives a significant amount of recreational use due to its relatively easy access and close proximity to several communities.

Dispersed (or primitive) camping is defined as anyone who stays overnight in the National Forest outside of developed facilities, involving a temporary shelter (tent, van, pickup camper, recreational vehicle, etc.). Campers select a location that meets their needs, erect their own accommodations and often use the "site" as a central base camp for participation in other outdoor activities. Attributes or qualities of the site's location (e.g., nearby stream, scenery, ease of access, vegetation, topography, etc.) help to determine a site's popularity among campers. These attributes explain why so many of the Bighorn National Forest's approximately 3,000 inventoried dispersed campsites (outside of wilderness) are located along waterways. These sites are finite in number and often located in a fragile (riparian) ecosystem.

According to the 1999 Bighorn National Forest monitoring report, 20% of the inventoried dispersed campsites did not meet 1985 Forest Plan standards and guidelines (i.e., they were not Frissell Condition Class 1-3). The following chart displays those campsites by geographic area.

Table 3-97. Dispersed campsites by geographic area (outside Cloud Peak Wilderness).

Geographic Area	# sites	% of Forest total
Tongue	633	21.1%
Goose Creek	490	16.4%
Clear/Crazy	484	16.2%
Tensleep	335	11.1%
Little Bighorn	254	8.5%
Shell	247	8.3%
Devil Canyon	241	8.1%
Paintrock	162	5.4%
Piney/Rock	146	4.9%
Total	2992	1%

There are an additional 1,387 dispersed campsites that were inventoried in the Cloud Peak Wilderness in the mid 1980s.

Off-highway vehicle (OHV) use has experienced significant growth in popularity on the Bighorn National Forest since the beginning of the current planning period. Participation in this activity depends on a system of roads or trails for primary access. Transportation is by a motorized vehicle (for the purposes of this discussion this category includes use by ATVs, snowmobiles, or motorcycles).

There are over 700 miles of system trails open to ORVs, 286 miles of which are snowmobile trails. Trails are discussed in greater detail in the Trails section below.

Motorized travel on the majority of the Bighorn National Forest is currently restricted to system roads and trails. However, at the onstart of forest plan revision, there were four remaining “C” areas designated on the forest travel map (see table below). These areas allowed travel off system roads and trails provided that such travel does not inflict damage to the land.

Table 3-98. Bighorn National Forest “C” areas.

Existing C Areas	Acres
Powder River District - general vicinity of Elgin Park	46,653
Medicine Wheel/Paintrock District - general vicinity of Horse Creek Mesa	30,204
Tongue District - general vicinity of Woodrock	23,868
Powder River District - general vicinity of Hazelton Peaks area	22,860
Total Existing C Area Acres	123,585

In March of 2005, decisions were made by the Tongue and Powder River Ranger Districts which closed three of the above areas to off-route motorized travel and designated a appropriate motorized system of travel routes. The Medicine Wheel/Paintrock Ranger District has initiated project-level travel management planning for the Hunt Mountain area.

Trails - Supply

Forest system trails provide the means of access for many dispersed recreation activities. The Forest has approximately 1,158 miles of combined winter and summer trails with 143 miles within the Cloud Peak Wilderness, including 12 miles of National Recreation Trail (Bucking Mule Falls). This mileage also includes groomed snowmobile and ski trails. There are a total of 11 developed trailheads with a capacity of 1,001 PAOTs. The majority of trailheads are undeveloped with no facilities, some with spacious area for parking, others with limited parking area.

Motorized system trails include those trails where OHVs are acceptable uses. There are over 432 summer miles open to motorized vehicles. Nonmotorized trails include those trails for hiking, horseback riding and mountain biking. There are 399 miles of summer

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nonmotorized trail miles on the Bighorn National Forest. Total miles includes miles of trail added to the Forest trail system with the 1997 Little Goose/Park Reservoir decision on the Tongue Ranger District and miles of trail in the Cloud Peak Wilderness. The following table displays approximate trail miles on the Bighorn National Forest.

Table 3-99. Bighorn National Forest trail system mileage by use.

Use Type	Snow Trails	Non-snow Trails
Motorized	286	432
Nonmotorized	41	399
Totals by Snow/Non-snow	327	831

Snow and non-snow trail miles shown in the above table are not exclusive of each other. In other words, some but not all of the 327 miles of snow trails are also used as summer trails, in part because some snowmobile trails are located in wet areas and are not suitable as summer trails due to the high potential for resource damage that can occur when the ground is not frozen. The following table shows allocation of snowmobile trails within the Forest by county.

Table 3-100. Forest snowmobile trail miles by county.

County	% of total snowmobile trail miles
Big Horn	38%
Sheridan	37%
Johnson	20%
Washakie	5%

Trailheads are an important point of access to the Forest's trail network. Currently, the majority of trails (634 miles) are not accessed by a developed trailhead, although these facilities attract a large share of the overall users. Trailhead use is generally split unevenly between weekend and weekday, but the following table provides an average.

Table 3-101. Summer use developed site trailheads and associated trails.

Trail Name and Trailhead Location	Nonmotorized Trails outside Wilderness (miles)	Wilderness Trails (miles)	Motorized Trails (miles)	Capacity (PAOT)*	Season-long Capacity**
Bucking Mule Falls	14.9	0.0	0	90	12,510
JAWS	14.9	0	0	46	6,394
Coney	5.6	1.8	0.0	80	11,120
Battle Park	0.9	6.4	18.5	75	9,300

Trail Name and Trailhead Location	Nonmotorized Trails outside Wilderness (miles)	Wilderness Trails (miles)	Motorized Trails (miles)	Capacity (PAOT)*	Season-long Capacity**
Circle Park	2.4	13.0	0.0	70	11,550
Edelman	0.6	5.6	0.0	50	6,200
Hunter	26.7	22.7	1.8	133	21,945
West Tensleep Lake	3.6	17.5	0.0	250	34,750
Elgin Park	2.6	0.0	9.3	70	11,550
Paintrock Lake	0.0	8.3	13.9	60	7,440
Coffeen Park	1.0	20.1	0.0	25	3,475
Total	73.2	95.4	43.5	949	136,234

*PAOT Capacity is defined as 3.5 people at one time per parking site.

**Season-long Capacity is PAOT capacity multiplied by number of days in a season.

Access issues have been a continuing concern of the public. This is discussed in additional detail in the Lands section of this chapter.

Dispersed Recreation Demand and Trends

Demand for dispersed recreation opportunities on the Bighorn National Forest is expected to rise. According to the *Social Assessment of the Four-County Area*, favorite activities among local residents included (in order of ranking): fishing, camping/picnicking, hunting, enjoying the scenery, and hiking/backpacking.

The Rocky Mountain Region is expected to experience an increase in hunting participation though 2050 even though hunting participation has declined 7% nationwide in the past decade. The expected increase is likely due to the fact that the Rocky Mountain Region is largely rural, and rural Americans are more likely to be hunters (CSF 2003). In addition, the Region is rich in public lands acreage and will be attractive to users from other areas. It is also important to realize that hunting is not an exclusive category. Among anglers, hunters and wildlife watchers, there is a considerable overlap in activities. In 2001, 71% of hunters also fished, and 27% of anglers hunted. In addition, 58% of anglers and 62% of hunters participated in wildlife-watching activities, while 33% of all wildlife watchers reported hunting and/or fishing during the year (USFWS 2002).

Table 3-102. Fishing visitation (primary visits).

Fishing – Primary Activity Visits		
Year	2001	2010
# of primary visits	89,472	95,424
% change	--	+6.7%

Source: Bighorn NVUM data, State of Wyoming, and Bowker et al. (1999).

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Bighorn National Forest recreation projections indicate that big game hunting demand will grow during the next planning period and beyond, although the growth will not be as pronounced as with such activities as wildlife watching, viewing scenery, interpretive experiences or OHV riding. The following table displays 2001 and projected 2010 hunter visitation levels.

Table 3-103. Big game hunting visitation (primary visits).

Hunting – Primary Activity Visits		
Year	2001	2010
# of primary visits	115,419	120,753
% change	--	+4.6%

Source: Bighorn NVUM data, State of Wyoming, and Bowker et al (1999).

Hiking is a popular activity on the Forest, ranging from both short day hikes to extended trips into the Cloud Peak Wilderness or other primitive areas. Use projections are shown in the following table.

Table 3-104. Hiking visitation (primary visits).

Hiking – Primary Activity Visits		
Year	2001	2010
# of primary visits	58,157	61,697
% change	--	+6.1%

Primitive camping (also referred to as “dispersed camping”) is a primary use of the Forest involving camping at areas other than at developed campgrounds, particularly among state residents. Unlike other activities, use increases as income decreases. Rural residents are more likely to primitive camp, than urban residents. In contrast to campers in developed campgrounds, the majority of primitive campers are Wyoming residents (83%) (Strong, 1997). On a forestwide scale, the demand for primitive camping is projected to only slightly increase, as shown in the following table:

Table 3-105. Primitive camping visitation (in primary visits).

Primitive camping – Primary Activity Visits		
Year	2001	2010
# of primary visits	19,783	19,967
% change	--	+.9%

Source: Bighorn NVUM data, State of Wyoming, and Bowker et al. (1999)

Past demand associated with primitive camping has resulted in an increase in the number of primitive campsites throughout the forest since unlike developed campsites, primitive campsites are created by the user. A primitive campsite survey that was conducted for the 1997 Clear Creek and Crazy Woman Creek Landscape Analysis arrived at some effects conclusions which can also be applied forestwide; many of these campsites are resulting in

impacts to vegetation and riparian areas, and are growing in size of their “Core areas” (the most-used area of the campsite).

Nationally, OHV use continues to grow in popularity. This same growth is likely to occur on the Bighorn National Forest. Because of this growth, there is a greater potential for future conflicts between motorized recreationists and those seeking a more primitive experience on the forest as well as other users of the Forest (range permittees, etc.). In addition to the actual increase in use of OHVs on the Bighorn National Forest, the technology itself is improving, allowing users an ever-increasing range of movement within the forest.

Table 3-106. OHV-related visitation (primary visits).

Year	OHV Use – Primary Activity Visits	
	2001	2010
# of primary visits	27,239	28,835
% change	--	+5.9%

Source: Bighorn NVUM data, State of Wyoming, and Bowker et al. (1999)

Although motorcycles are a popular form of travel on the Bighorn National Forest, most of the recent increase in OHV numbers on the Forest came from ATVs instead of motorcycles. According to the Bighorn Social Assessment, respondents indicated a desire for designated ATV trails, although neither snowmobiling nor ATV/OHV use ranked among the top favorite activities for these local respondents.

Corresponding with the increased OHV use on the Forest is a greater demand on Forest personnel and resources with regard to enforcement of OHV-related travel regulations. Forest law enforcement is spending a greater amount of time on OHV-related offenses as a percentage of total offenses. OHV-related offenses as a percent of total offenses increased from 24% in 2002 to 39% in 2004.

As of January 1, 2002, all OHVs (ATVs, dirt bikes, etc.) are required to display a Wyoming ORV permit while operating on public lands and other designated trails and areas, mirroring the current snowmobile registration requirements. The Forest will increasingly rely on funding from this program to implement their trails program and provide assistance with enforcement.

It is interesting to note that the 2001 NVUM survey indicated that only a small fraction of visitors visited the Forest with the primary purpose of mountain biking (less than 100 visits during the year). This indicates that mountain bike use should not be so great as to create management issues during the next planning period.

Forest use data indicates that snowmobile use will increase between 2001 and 2010 by 10 percent. This growth is likely to continue, as demonstrated by repeated rankings of the Big Horn Mountains by SnoWest magazine among the nation’s “Top 10” snowmobile trail systems (SnoWest 2002).

Table 3-107. Snowmobile visitation (primary visits).

Year	Snowmobile use – Primary Activity Visits	
	2001	2010
# of primary visits	26,742	29,413
% change	--	+10%

However, it is interesting to note that that the Bighorn Social Assessment of the Four-County Area (2002) indicates that fewer than 5% of the 4-county area respondents list snowmobiling or ATV/off road among their three favorite Forest activities.

Finally, Tongue River cave receives recreation use year-round, with many visitors coming unprepared with little knowledge of resource protection or safety. Other caves on the Forest receive very infrequent use, primarily due to more difficult access.

The Scenic Byway Corridor Management Plan identified a need for trails accessed from the three highway corridors. Also identified in this plan, was a desire for more and larger parking areas for winter recreation. According to the Bighorn Social Assessment, respondents indicated a desire for designated ATV trails. These are site specific issues which would be addressed at the project specific level as opposed to Forest Planning.

Given the layout of the Bighorn National Forest, with three US Highways crossing it, viewing scenery and pleasure driving are the predominant recreation activities on the Forest. The 2001 NVUM survey identified “Viewing natural features” as the single most popular recreation activity on the forest. The recreation analysis grouped “viewing natural features” along with “viewing wildlife”, as shown in the following table.

Table 3-108. Viewing-related visitation (primary visits).

Year	Nature-related activities (Viewing scenery and wildlife) Primary Activity Visits	
	2001	2010
# of primary visits	188,289	202,987
% change	--	+7.8%

Dispersed Recreation Issues

Conflict between motorized and nonmotorized users is a frequently cited concern from the public. Conflicts can interfere with the experiences of both users. User conflicts are most often associated with user behavior, and although managers can’t dictate behavior, user conflicts on multiple use trails are a growing concern.

Trail use changes that weren’t anticipated in the 1985 Plan include increases in the amount and type of mechanized uses, particularly snowmobiles, and off road vehicles (ORVs). The Forest has 432 miles of summer motorized trails, and use of licensed or state-stickered ORVs on open Forest Service roads is allowed, unless otherwise noted.

Much discussion thus far in this section has pertained to motorized recreation. That does not mean that nonmotorized recreation does not have impacts. However, the ease of access and the greater distance that can be covered by a motorized recreator, and as a result the potential for disturbance and conflict with other Forest users is also greater. In addition, the amount of comments received during pre-revision scoping meetings around the 4-county area as well as the public comment period on the Draft Plan and DEIS reflected a greater concern over existing motorized use compared to nonmotorized use.

Some commenters on the Forest planning effort noted that they would like to see the Forest restrict motorized travel to designated routes and close areas to motorized use where it disturbs wildlife and damages riparian areas. They expressed the need for trails for hiking, ATV and motorcycles, and mountain bikes, but would also like areas for nonmotorized use that are designated, managed and enforced, both for winter and non-winter. In order to maintain current experiential satisfaction for these additional users, the Forest may need to build additional trails.

However, due to budgetary limitations, the ability of the Bighorn National Forest to construct or reconstruct trails is limited and fluctuates significantly in accordance with funding levels. For example, in FY 2001, the Forest employed a seven-person trail crew, accomplishing fifteen miles of heavy trail maintenance, rerouting and segment reconstruction (restoration of the Kearney Creek Bridge). In FY 1999, 1.5 miles of trail were reconstructed (east Tensleep Lake Trail Reroute). In 2002, the Forest was unable to fund a trail crew. Funding from the State Trails Program will factor ever more heavily in Forest trail management.

As per agency requirements, the Bighorn National Forest conducts condition surveys on approximately 20% of its Forest trail system annually. Analysis of recent maintenance surveys, coupled with observations from field personnel and public trail users, confirms that the priority list of critical maintenance needs is increasing and that overall trail conditions on the Bighorn National Forest continue to decline (USDA Forest Service 2001). A major factor contributing to the deterioration is that Forest system trails are often based on historic user-created trails which were improperly located when they were initially created – particularly with regard to riparian areas, fall lines and erosive soils. When heavy use occurs in conjunction with improperly located trails, rapid trail deterioration occurs.

Other advances in technology beyond the advent of newer and more effective transportation continue to change the face of dispersed recreation. The dramatic increase in popularity of Global Positioning System (GPS) devices has made backcountry orienteering much simpler and reduced the associated risk as well as the level of proficiency needed to access remote areas of the Bighorn National Forest. It has even resulted in a new form of recreation – geocaching – which is essentially a 21st century version of “hide and seek” where individuals or organizations set up caches and share locations of these caches on the Internet. GPS users locate the cache by coordinates and find a variety of treasures and a sign-in logbook. At present there are several geocache sites on the Bighorn National Forest but based on past growth in other adjoining states, the

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Bighorn National Forest will likely see a proliferation of geocache sites as well. Colorado experienced a ten-fold increase in geocache sites between 2002 and 2003 (Swain, 2003).

Volunteers have been, and continue to be, a critical component of trail maintenance and improvement on the Bighorn National Forest. In FY2001, volunteers, working with Forest personnel, accomplished approximately 60 miles of light maintenance. In FY 1999, volunteer groups cleared downfall on over 160 miles of trails and did extensive drainage work on an additional 5 miles of trail (USDA Forest Service 2000).

Unrestricted motorized travel in “C” areas as designated on the travel map has encouraged the development of new, as well as reinforced existing, user-created trails. User-created trails are a concern because of their potential for resource damage. Illegal motorized vehicles causing resource damage is the most frequently cited offense on the Bighorn National Forest. Currently, three of the four “C” areas that existed at the beginning of plan revision have now been addressed. The remaining “C” area, in the vicinity of Hunt Mountain, will be the subject of travel planning efforts during 2005 and 2006 which will designate an appropriate network of motorized routes. Effects of forest plan revision on this area are discussed in the Environmental Consequences section.

Winter Recreation Supply

In this section, winter recreation will primarily include cross country and downhill skiing. Snowmobiling, the most popular winter activity on the Bighorn National Forest, was discussed in the Dispersed Recreation section.

There are two developed downhill ski areas on the Forest that provide over 10,000 skier visits per year with a total of 620 PAOTS. Both ski areas have expanded and improved operations within the past five to ten years. Both areas primarily service local residents from the 4-county area. Antelope Butte ski area did not open for the winter of 2004-2005, citing a lack of snow and a lack of attendance (CST 2004).

There are 41 miles of cross-country ski trails groomed by the Forest Service and volunteers. There are three warming huts and two cross-country skiing parking lots/trailheads, providing a total of 102 PAOTs.

There are numerous currently undesignated areas popular with backcountry (often referred to as telemark) skiers. Among those identified during the public comment period are Powder River Pass, the Salt Creek and Turkey Creek drainages, Trigger Lake Road area, and the bowls northwest of Antelope Butte.

A concentrated winter use area is located around Meadowlark Lake where snowmobiling, cross-country skiing, family snow play, ice fishing, and downhill skiing are popular activities. Other parking areas along U.S. Highway 16 provide access to snowmobile and/or cross-country ski trails. Similarly, snowmobile use is heavy on the north end of the Forest along U.S. Highway 14 and 14A in the Burgess Junction area, with access gained via roadside parking areas. Cross-country skiing occurs in these locations, as well as at the Antelope Butte ski area.

Pole Creek and Willow Park on U.S. Highway 16 and Sibley Lake and Antelope Butte on Highway 14 are the only areas reserved solely for cross-country skiing. Snow play (i.e. sledding) occurs at a few locations, including the Cutler Hill area.

A separate ROS classification is given to winter recreation activities. The primary factors that distinguish one class from another are motorized versus non-motorized access and ease of that access. The following classes have been identified:

Primitive (P): 113,689 acres (10%); all wilderness acres

No motorized access is allowed. This encompasses the “core” of the Cloud Peak Wilderness Area and at least three miles from snowmobile routes and trailheads accessed by motorized vehicles.

Semi-Primitive Nonmotorized (SPNM): 153,272 acres (14%); 78,208 wilderness acres and 75,064 non-wilderness acres

This includes areas a minimum of one-half mile from motorized routes where motorized access is restricted by travel regulation. These areas are a minimum of 2,500 acres in size.

Semi-Primitive Motorized (SPM): 789,854 acres (71%); all non-wilderness acres.

This is the largest ROS class for winter recreation. It includes all areas not in the primitive, semi-primitive non-motorized, and roaded natural classes. Use of snowmachines is allowed on much of this acreage, provided snow is available.

Roaded Natural (RN): 55,613 acres (5%); all non-wilderness acres

These areas are located along the major highways, U.S. Hwy 14 and U.S. Hwy 16. There is more concentrated activity along these corridors since most winter trailheads and parking areas are located along these routes.

Winter Recreation Demand and Trends

Demand for winter recreation is expected to rise, with the greatest increases anticipated amongst snowmobiling and cross-country skiing. Cross-country skiing not only includes skiing at designated cross-country ski trails on the Forest but also backcountry skiing.

Table 3-109. Downhill skiing visitation.

Year	Downhill Skiing – Primary Activity Visits	
	2001	2010
# of primary visits	3,181	3,371
% change	--	+6.0%

Source: Bighorn NVUM data, State of Wyoming, and Bowker et al. (1999)

Downhill skiing on the Forest has been on a slightly increasing trend. At this rate, the existing supply should continue to accommodate anticipated demand during the next planning period. An extended closure of Antelope Butte ski area could displace skiers to either the Bighorn Mountain Resort, creating the potential for crowding there, or to non-Forest ski areas in the region (e.g., Red Lodge, Montana).

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Cross-country skiing is growing in popularity on the Forest. This involves both skiing at developed cross-country ski trails, as well as more dispersed, backcountry skiing. Demand projections for this activity are shown below.

Table 3-110. Projected demand for cross country skiing.

Cross Country Skiing – Primary Activity Visits		
Year	2001	2010
# of primary visits	13,719	14,672
% change	--	+6.9%

Source: Bighorn NVUM data, State of Wyoming, and Bowker et al (1999)

Recreation Special Uses Supply

There are 344 recreation special use permits within the Forest. The breakdown is as follows:

- ◆ 265 recreation residences.
- ◆ 53 outfitter and guide permits.
- ◆ 10 resort permits.
- ◆ 3 organization camp permits.
- ◆ 2 downhill ski area permits (1 currently not operating).
- ◆ 1 campground concessionaire permit.
- ◆ 10 recreation event permits (This is an average per year).
- ◆ Noncommercial group use permits (varies, but overall is insignificant).

Currently there are 53 outfitter/guides providing services throughout the year. Twenty-one of those outfitters provide service in the Cloud Peak Wilderness. The following table displays existing activities and numbers of service days¹⁴ issued on the forest.

Table 3-111. Outfitter and guide service days on the Bighorn National Forest.

Outfitter/guide Service Days by activity by district				
Activity	Tongue	Powder River	Medicine Wheel/Paintrock	Totals
Spring				
Spring bear hunting	149	0	75	224
Summer				
Trail rides,camping, fishing	2,650	10,616	1,979	15,245
Fishing	80	172	206	458
Cattle drives	180		390	570

¹⁴ A service day is defined as “a day or any part of a day on National Forest System lands for which an outfitter or guide provides goods or services, including transportation, to a client.”

Outfitter/guide Service Days by activity by district				
Activity	Tongue	Powder River	Medicine Wheel/Paintrock	Totals
Rock climbing		160		160
Backpacking		660		660
Environmental education, backpacking			1,790	1,790
Fall				
Big game hunting	441	245	2,192	2,878
Winter				
Snowmobile guiding	1,600	1,750	790	4,140
Dog sledding			20	20
Lion hunting	40	40		80
Total service days provided for outfitting				26,225

2003 permit information

Recreation Residences: There are 265 cabins on the Forest, located within 36 summer home groups and 45 isolated cabin tracts. This comprises the largest number of recreation residence permits on one Forest in the Rocky Mountain Region. The majority of the recreation residences are in rural and roaded natural ROS classes. Many are located within the scenic byway corridors along U.S. Highways 14, 14A, or 16.

In many areas, this use has existed since 1925. The purpose of allowing recreation residences was to encourage use of the National Forests by allowing individuals to build cabins for recreational purposes and occupy them for a portion of the year. The program was very popular, and several thousand permits were issued nationwide. Permits for the recreation residences are issued for 20 years, with most permits on the Forest set to expire in 2008.

The current national policy is to not issue any additional permits. The Forest recognizes the recreational values associated with the recreation residences. Correctly issued, existing permits will be reissued when the current permit tenure expires provided the recreation residences were operated in compliance with the terms and conditions of the permit. The sheer number of permits on the Forest creates an administration challenge.

Resorts: Resort permits also fall under the auspices of the Occupancy Permits Act. There are 10 resort permits, with a wide range of opportunities offered. Permit owners have been working to expand operations, diversify services, and upgrade facilities to address the changing needs of the public.

Recreation Special Uses Demand

Demand for outfitter and guide special use authorization continues to grow. Prior to the 1997 limit on the issuance of new permits, there was a significant increase in requests for new permits. The Forest received over 60 inquiries for new permits and uses during 1996

including a variety of uses from mountain biking to hang gliding to ATV tours. At the time, hunting and fishing outfitter-guide use was already considered to be at capacity. By updating the number of service days on the existing permits, moderate changes in demand have been accommodated.

In February, 2002, a needs analysis questionnaire was sent out to a mailing list of 128 recipients that included existing outfitter/guides permitted on the Bighorn National Forest, several persons that have requested to be permitted as an outfitter/guide, and local Chamber of Commerce Offices and other interested parties. According to respondents:

- ◆ There was a need for additional outfitter/guide services on the Forest.
- ◆ Environmental education-related outfitter services were frequently mentioned as needed.
- ◆ Other services that were requested were ‘nontraditional’ services such as rock climbing and llama trekking.

Demand for recreation event and semi-public permits, in general, also continues to rise. Demand for recreation events and institutional permits has also risen as evidenced by the number of requests received from the public.

Recreation Special Uses Issues

The Forest has initiated a capacity determination analysis outside the forest plan revision process which will help it to determine proper outfitter/guide service levels.

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General Effects

Recreation management is concerned with providing a range of recreation opportunities to meet the needs of users and local communities in balance with protection of forest resources. All forest management alternatives provide for recreation opportunities, but to varying degrees of overall mix of opportunities.

The following two tables are based upon the 2001 Forest National Visitor Use Monitoring Survey data. They are different from the DEIS in that the numbers are based on primary visits instead of Recreation Visitor Days and are derived from the more statistically valid National Visitor Use Monitoring Survey (see the beginning of the recreation affected environment section for additional discussion).

It is likely that visitation to the Forest will increase during the next planning period, regardless of the alternative chosen. However, a slight variance is expected when comparing Alternatives A and E to the rest of the alternatives based on the ability of the recreation program to maintain its offering of developed facility-based recreation opportunities.

In Alternatives B, C, D-DEIS, and D-FEIS, recreation budget levels (as a share of the total Forest budget) would not be noticeably different from the current situation and as a result, no variance in recreation visitation to 2010 is anticipated.

Table 3-112. Primary baseline visitation levels under Alternatives B, C, D-DEIS, and D-FEIS.

Baseline Forest Primary Visitation Levels (Alternatives B, C, D-DEIS, D-FEIS)			
Activity	2001	2010	% Growth
Cross-country Skiing	13,719	14,672	+6.9%
Snowmobiling	26,742	29,413	+10.0%
Downhill skiing	3,181	3,371	+6.0%
Hunting	115,419	120,753	+4.6%
Fishing	89,472	95,424	+6.7%
Viewing scenery/wildlife	188,289	202,987	+7.8%
OHV use	27,239	28,835	+5.9%
Driving	54,677	56,702	+3.7%
Developed camping	12,128	13,042	+7.5%
Primitive camping / backpacking	19,783	19,967	+0.9%
Hiking	58,157	61,697	+6.1%
Other	122,080	129,628	+6.2%
Total	730,887	776,492	+6.2%

In Alternatives A and E it is projected that the recreation budget would be slightly reduced to accommodate the need to administer an increased timber program in those alternatives. In response to the reduction in the recreation budget, it is anticipated that the non-concessionaire-operated campgrounds and picnics areas would be closed, resulting in a reduction in picnicking and camping visitation on the Forest.

Table 3-113. Primary visitation levels under Alternatives A and E.

Varied Forest Primary Visitation Levels (Alternatives A and E)			
Activity	2001	2010	% Growth
Cross-country Skiing	13,719	14,672	+6.9%
Snowmobiling	26,742	29,413	+10.0%
Downhill skiing	3,181	3,371	+6.0%
Hunting	115,419	120,753	+4.6%
Fishing	89,472	95,424	+6.7%

Varied Forest Primary Visitation Levels (Alternatives A and E)			
Activity	2001	2010	% Growth
Viewing scenery/wildlife	188,289	202,987	+7.8%
OHV use	27,239	28,835	+5.9%
Driving	54,677	56,702	+3.7%
Developed camping	12,128	12,521	+3.2%
Primitive camping / backpacking	19,783	19,967	+0.9%
Hiking	58,157	61,697	+6.1%
Other	122,080	120,348	-1.4%
Total	730,887	766,690	+4.9%

Quantifiable projection of visitation beyond 2010 is not reliable, due to the likelihood of unanticipated variables such as cost of fuel, changes in recreation technology, etc. For example, the 1985 Plan did not anticipate the popularity of the ATV on the Bighorn National Forest because it essentially did not exist at the time. However, it is not unreasonable to assume that the small reduction in visitation in Alternatives A and E could become more pronounced in comparison to the other alternatives beyond 2010.

Use level projections for Alternatives A, B, C, D-DEIS, and D-FEIS are based on the estimate that timber management activities at the forestwide scale would remain generally similar to current operations. Consequently, there was not enough basis to predict an effect on visitation (i.e., significant alterations of scenic integrity, roading, etc) that varies from the baseline.

Under Alternatives A and E, it is estimated that the Forest would have to reduce recreation funding from recent levels and use that money to support the higher timber activity levels. As a result of the shift of funds from the recreation program in Alternatives A and E, it is unlikely that the Forest would be unable to continue to operate non-concessionaire picnic and campground facilities at their existing levels. It is not anticipated that concessionaire-operated facilities would be closed under Alternatives B, C, D-DEIS or D-FEIS.

These numbers do not account for possibilities of large-scale disturbance events such as fire. While large scale natural disturbance events have the potential to displace recreationists elsewhere, it is unlikely recreationists would move off the Forest since the Big Horns are an island range and the similar opportunities are several hours away in any direction.

The Communities section of this chapter discusses the importance of tourism-based recreation to the local economy. The timeframe of the economic analysis is from 2001 to 2010. The analysis also considers historic levels of forest management. Very little variance in recreation use is anticipated among alternatives.

Range of Opportunities Based on Recreation Opportunity Spectrum (ROS) Classes

The Forest is managed to provide opportunities for a wide variety of recreational experiences. The Recreation Opportunity Spectrum (ROS) has been developed to help identify, quantify, and describe this resource.

Vegetation, scenery, water, topography and wildlife are all important elements of a recreation setting. They influence where people go and the kinds of activities that are possible in those areas. They help to define the type of recreational experience the visitor is likely to have. Changing these elements is likely to change the mix of recreation opportunities.

The following figure illustrates the mix of adopted ROS classes (based on management area prescription guideline) by alternative. The adopted ROS class displays the maximum level of change that an area could experience in terms of ROS shift over the life of the plan. It is likely that actual on-the-ground shift from the current ROS composition will be far less extreme than portrayed below, given the historical annual management on the Forest and that which will likely occur over the next planning period.

Table 3-114. Adopted ROS by alternative.

ROS Category*	1998 Forest ROS inventory	Alternative					
		A	B	C	D-DEIS	D-FEIS	E
P	181,232	154,769	178,190	190,827	173,219	179,062	148,674
SPNM	278,105	185,277	223,212	262,605	175,920	201,279	96,785
SPM	372,549	172,972	331,361	385,763	180,471	163,864	61,953
RM	106,532	454,766	203,017	89,022	394,429	381,833	631,486
RN	140,393	127,327	139,813	147,774	148,337	147,984	159,850
R	32,544	9,906	29,422	29,025	32,641	30,994	6,269

*P = primitive, SPNM = semiprimitive nonmotorized, SPM = semiprimitive motorized, RM = roaded modified, RN = roaded natural, R = rural

Based on shifts to ROS composition from the more primitive end of the ROS spectrum to the more developed end, users and use types will most likely be affected by implementing Alternative E followed by A, D-DEIS, D-FEIS, B, and C primarily based on the level of timber management and management area allocation.

The amount of ROS shift by alternative (in percent) by ROS class, compared to the 1998 Forest ROS map, is shown in the following table.

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Table 3-115. ROS shift comparison to 1998 Forest ROS Map (in percent) by alternative.

ROS Category*	Alternative					
	A	B	C	D-DEIS	D-FEIS	E
P	-15%	-2%	+5%	-4%	-1%	-18%
SPNM	-33%	-20%	-6%	-37%	-28%	-65%
SPM	-54%	-11%	+4%	-52%	-56%	-83%
RM	+327%	+91%	-16%	+270%	+258%	+493%
RN	-9%	0%	+5%	+6%	+5%	+14%
R	-70%	-10%	-11%	0%	-5%	-81%

As discussed previously, the analysis that determined the above ROS acreage figures is based on the “Adopted ROS” guideline for each management area and assumes that every acre would shift under Revised Plan implementation. This is not likely to be the case and as such, the magnitude of change that is likely to occur is exaggerated. The utility of this analysis is for purposes of alternative comparison.

Alternative E could most dramatically reduce the amount of primitive and semi-primitive nonmotorized acreage compared to 1998 ROS-mapped levels, while most dramatically increasing the amount of roaded ROS acreage. This could result in a greater likelihood of crowding among nonmotorized recreationists such as hikers, horseback riders and nonmotorized winter recreationists while potentially creating additional opportunities

Conversely, Alternative C would result in the least amount of ROS shift from current conditions. As such, it would maintain the highest level of primitive and semi-primitive nonmotorized recreation opportunity. Lying within the range of ROS shift between Alternatives C and E (in terms of least to most magnitude of change) would be Alternatives B, D-FEIS, D-DEIS, and A.

The greatest loss of primitive and semi-primitive ROS settings would be experienced in Alternative E, followed by A, D-DEIS, D-FEIS, and B. Alternative C would have the least. The primitive and semi-primitive settings are popular, primarily for the challenge and sense of risk that they offer the recreationist.

On the other end of the spectrum is the roaded natural ROS, a popular setting among ORV enthusiasts, pleasure drivers, hunters, and dispersed campers. Roaded Natural acreage would remain relatively stable across alternatives, ranging from Alternative E (most) to Alternative A (least).

There is a difference between adopted ROS class and whether or not recreation opportunities are actually available. Opportunities need to be provided, including trail development, and other user conveniences or facilities in some cases. Simply because an area has an adopted ROS class of semi-primitive motorized, for example, does not mean that motorized travel will be able to occur there unless a motorized trail system is also

present. Trails and facilities are dependent upon funding. The State Trails Program provides grant funds that would be available to the Forest in any alternative.

Dispersed winter recreation opportunities are discussed in the “dispersed winter recreation” effects section below.

Direct and Indirect Effects

Effects of Revised Plan Direction on Developed Recreation (Campgrounds, Ski Areas): The recreation program is dependent on budget and prioritization. Campgrounds are a considerable public investment whether operated under concessionaire permit or not. Campgrounds should not noticeably vary among alternatives aside from a slight reduction in available supply in Alternatives A and E (as discussed previously in the General Effects section).

Allocation of land for potential ski area development is consistent with the forest planning process. Allocation does not preclude the need for a Master Plan, complete with NEPA, as required by Forest Service regulations. Alternative A and D-FEIS would maintain the existing ski area boundaries as shown in Management Area 8.22. Alternatives B, C, D-DEIS, and E would expand the MA 8.22 boundaries to nearly 2,600 acres. Capacity at existing ski areas will be adequate to meet demand during this planning period.

Should the Forest be determined to be occupied lynx habitat, future expansion of the Antelope Butte ski area would be addressed under revised plan direction related to lynx management. Big Horn Mountain Ski Area is not located within a lynx habitat unit and would not be subject to the same provisions as Antelope Butte. This effect would be similar across all alternatives. See the wildlife section of this chapter for additional discussion.

Effects of Revised Plan Direction on Dispersed camping: The Revised Plan contains several provisions related to dispersed camping. Across all alternatives, a forestwide standard in the Revised Plan will restrict, or address through mitigation, as much as 8,408 acres to dispersed camping (in addition to existing Special Orders already in place). This is a tradeoff. Some of the acreage includes areas that are currently popular dispersed camping areas. This will result in added competition for existing dispersed campsites, as well as demand for additional areas where dispersed camping opportunities will be available. There are three additional Revised Plan provisions relevant to dispersed camping. Effects from implementation of this Revised Plan direction will occur as the result of project-level decisions regarding dispersed camping.

- ◆ A forestwide guideline which prohibits dispersed camping within ¼ mile of developed campground facilities unless otherwise designated.
- ◆ A forestwide guideline under which the Forest will concentrate dispersed campsites.
- ◆ A forestwide guideline under which the Forest will evaluate existing dispersed sites within 100 feet of streams or lakes for hardening, closure, or other mitigation. New sites should not be established in areas within 100 feet of streams or lakes.

Effects from Travel Management on Dispersed Recreation: Trails help disperse users and provide them with a sense of solitude. At the beginning of plan revision, 11% of the Forest was designated as a “C” area on the existing travel map. In “C” areas, wheeled,¹⁵ motorized, off-route travel is permissible provided resource damage is not occurring. With increasing visitor levels and an increasing number of vehicles such as ATVs and motorcycles, it is no longer possible to allow this sort of unmanaged travel.

At the time of publication of the Revised Plan and Final Environmental Impact Statement, three of the four “C areas” that existed on the Forest (amounting to more than 93,000 acres) have been addressed through project-level decisions which prohibit wheeled motorized off-route travel. The Hunt Mountain area on the Medicine Wheel/Paintrock District will be addressed through plan revision. Wheeled motorized off-route travel will be prohibited, and concurrent project-level travel planning will define an appropriate system of motorized routes for this area. The travel planning effort is expected to begin in 2005, with completion anticipated in 2006.

Table 3-116. "C area" acreage at the start of plan revision.

C Area	Acres
Woodrock area	23,868
Hunt Mountain area	30,204
Hazelton Peaks area	22,860
Elgin Park area	46,653
Total	123,585

Snowmobile travel off designated trails, over snow, will still be allowed during approved times in areas where this use is permitted.

Given that wheeled motorized travel will be restricted to system routes on a forestwide basis, differences across alternatives in terms of wheeled motorized travel opportunities will generally be subtle, especially in the earlier years of the Revised Plan. However, the long-term potential for construction of new motorized routes (which is dependent on management areas which allow motorized travel) will be greatest in Alternative E (based on the amount of motorized ROS classes), followed by Alternatives A, D-DEIS, D-FEIS, B and C. Conversely, the long-term potential for maintaining the greatest amount of nonmotorized recreation opportunities will be highest in Alternative C, followed by Alternatives B, D-FEIS, D-DEIS, A and E.

Access to the Forest continues to be a concern. Under all alternatives, the Forest will prohibit motorized access from private land where access for the general public is not available, except by special authorization.

¹⁵ The term “wheeled motorized travel” is used to distinguish it from winter motorized travel via snowmobiles.

Anticipated annual trail construction / maintenance levels do not vary by alternative. Travel provisions regarding individual roads and trails are not being addressed through plan revision, but will be addressed through more site-specific travel management planning.

Under a forestwide strategy (discussed in Chapter 1 of the Revised Plan), the Forest will develop or identify a day-use trail system on a scenic byway during planning period. This would provide for an easily-accessible trail opportunity to the majority of Forest visitors traveling along one of the three scenic byways. The specifics of this day trail system (whether motorized, nonmotorized, etc.) will be determined at the project level. If funds are available and public demand exists, the construction or designation of additional day-use trails would not be precluded by the Revised Plan.

In Alternatives A and E, road construction may be needed to access timber in the Piney Creek/Rock Creek area. Given the length of the road needed, it is possible this road could remain open to public use as a level 3 road. This could create additional roaded travel opportunities, as well as the activities that typically go along with road-based recreation (fishing, hunting, camping, viewing scenery, etc). With this would also come the potential for additional conflict between nonmotorized users and the new introduction of motorized recreationists into an area that was previously generally unroaded. Under Alternatives C and D-FEIS, the Rock Creek area would remain in a nonmotorized state as a result of the wilderness recommendation.

Management Area 1.33 (Backcountry Recreation with Limited Summer and Winter Motorized Use) contains direction in the form of a recreation guideline which states “In the summer, manage for an the adopted ROS class of primitive or semi-primitive nonmotorized except on motorized system trails shown on the travel map which will have a semi-primitive motorized setting.” Management emphasis will be for no net gain or loss of motorized system trail routes until site-specific management decisions have been made. The following existing motorized system trails are located within Management area 1.33 in Alternative D-FEIS and will continue to remain open motorized trails until site-specific decisions regarding their final disposition are made.

Table 3-117. Alternative D-FEIS motorized trails within MA 1.33 (in miles).*

Trail		Alternatives				
#	Name	A	B	C	D-DEIS	D-FEIS
54	Railroad Springs	1.3	0.5			0.4
57	Shell Creek					0.3
59	N. High Park					1.6
61	Lodge Grass		5.7	5.7		
64	W. Tensleep Cutoff		1.2	1.2		0.7
84	ar Gulch		0.3			
94	Kinky White Cutoff					0.6
96	Boyd Ridge	1.9	1.9			1.9
100	Lake Creek		1.6			

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#	Trail Name	Alternatives				
		A	B	C	D-DEIS	E
104	Pete's Hole			3.0		
110	Antler		2.8	2.8		
116	Kinky White					3.9
146	Pumpkin	3.0	4.6		2.5	2.6
149	North Beaver			3.3		
151	Beaver Ck Mesa			3.3		
184	Shell Bench	5.4				5.1
217	Brush Creek	1.4			1.2	1.6
408	Saddle Crossing	0.2			0.2	0.4
419	Hudson Creek			3.1		
420	East Beaver			3.3		
817	Mail Creek					1.1
	Total miles	13.2	18.6	25.7	3.9	14.1

*Based on the best available information at the time - GIS trail inventory information as of June 2005. The Forest is currently in the process of updating/correcting its road and trail inventory and as a result, these numbers may change somewhat.

Effects from Management Area Allocations, Winter Range, Existing Orders, and Canada Lynx Direction on Dispersed Winter Recreation: Restrictions to winter motorized use based on management area allocation varies slightly by alternative. Several management areas, including Recommended Wilderness (MA 1.2), Backcountry Recreation Nonmotorized Use (MA 1.31), Wild Rivers (MA 1.5), Research Natural Areas (MA 2.2) aside from Lake McLain, and Deer and Elk Winter Range (MA 5.41) prohibit winter motorized recreation, including snowmobiles.

Big game winter range (as mapped by the Wyoming Game and Fish Department) is found in numerous areas on the Forest. In some cases, these areas prohibit winter motorized travel, but it does not vary by alternative. There are 27,294 acres of crucial mule deer winter range on the Forest (typed as "crucial winter yearlong"). There are a combined total of 41,077 acres of crucial elk winter range on the Forest (typed as crucial winter yearlong and crucial winter).

When the combined effects of mapped winter range, existing Special Orders, and management area allocation are taken into account, the total amount of winter motorized and nonmotorized acreage (including Cloud Peak Wilderness) can be compared by alternative. Total acreage of national forest open to snowmachine recreation by alternative is as follows:

The most Forest acres would be open to snowmachine travel in Alternatives A and E (72%), followed (in order) by Alternatives D-DEIS and D-FEIS (69%), B (68%), and C (61%). The most significant change is the recommendation of the Rock Creek Wilderness, which, while shown as open to snowmobiles on the existing travel map, is not in reality accessible to snowmobiles currently.

In terms of an overall effect on dispersed winter recreation, there is a greater possibility of crowding among snowmobilers in Alternative C. However, there is also greater potential for preserving quiet winter recreation areas for nonmotorized winter pursuits since this alternative most reduces the amount of available acreage to winter motorized recreationists. The rest of the alternatives are generally similar in effect, essentially maintaining the current available winter motorized acreage (particularly in Alternatives A and E) or reducing it slightly (D-DEIS, D-FEIS, and B) although effects on designated snowmobile trails would be negligible.

Based on a comments received during the public comment period, Alternatives C and D-FEIS incorporate the concept of using Management Area 1.31 (Backcountry recreation nonmotorized use) to set aside easily accessible nonmotorized winter recreation areas for backcountry skiers in the Cabin creek drainage vicinity south of the Antelope Butte ski area in Alternative C and the Turkey Creek and Salt Creek drainages in Alternative D-FEIS. Under Alternative D-FEIS, the eastern portion of Powder River Pass would be nonmotorized in the winter under a special order (as mentioned in the Record of Decision) although the management area allocation for the area will not include Management Area 1.31. The concept of using Management Area 1.31 was explored for the eastern portion of Powder River Pass. However, due to the presence of open system roads in the area, this approach (winter and summer nonmotorized) was deemed excessive given the desired management outcome of a winter nonmotorized setting. The western portion of Powder River Pass will remain open to snowmobiles. In the rest of the alternatives, all three of these areas would remain open to snowmobile travel, although Salt Creek, Cabin Creek, and Turkey Creek receive little if any snowmobile usage.

Should the Forest be determined to be occupied lynx habitat, over-the-snow winter recreation within lynx habitat, both motorized and nonmotorized, will be affected similarly across all alternatives by Revised Plan direction. See the wildlife section of this chapter for additional discussion.

Effects from ROS Shift and Wildlife Management on Wildlife Recreation:

Recreationists benefit from wildlife management, particularly those who hunt or enjoy viewing wildlife on the Forest. Wildlife-related recreation uses usually tend towards less modified environment, away from other people although the majority of recreationists do not usually venture far from roads and trails. Alternative C would result in the least amount of a more modified environment, with Alternatives E and A (in that order) resulting in the greatest ROS shift from the current forestwide settings.

Wildlife management can affect recreation opportunities through added restrictions on the nature, extent, location and timing of allowable recreation activities, which decrease the ability of recreationists to disperse. Closing or decommissioning roads or trails has this effect. By concentrating motorized recreationists on fewer miles of open routes, opportunities for motorized users seeking solitude are diminished although at the same time it creates greater opportunities for solitude for nonmotorized recreationists. Timing restrictions on seasonal closures during sensitive periods such as calving and migration,

and prescribed burning to improve habitats can temporarily displace recreationists to other areas.

Effects from Travel Management, Timber Management, and Aquatic Resource

Management on Fishing Use: Fishing use is dependent on stream health and on roads to access streams. Many anglers use OHVs to travel to streamside locations. Common to all alternatives is an annual decommissioning goal of four miles of system road per year. Stream sediment loading from unmanaged motorized use, and clearcutting upstream can affect fish populations and fishing opportunities. Fisheries would be most affected by higher levels of ground disturbing activities, such as timber harvesting and road building. Alternatives A and E emphasize these activities. Assuming proper implementation of Best Management Practices (BMPs), there should be no notable increase in sediment loading from timber management across all alternatives although a greater potential exists for an increase in short-term loading as a result of water crossings in the higher harvest alternatives (particularly Alternative E) as roads are built.

Fishing-related recreation is success-dependent on adequate amounts and distribution of habitat. Activities related to maintenance, restoration and protection of aquatic resources are similar across all alternatives.

Effects from Revised Plan Direction, Permit Re-issuance, Management Area Allocation, RNAs, and Canada Lynx Direction on Recreation-related Special Uses:

The number of **resorts** does not vary by alternative. Existing resort permits would continue to be administered as such in all alternatives. No additional resorts or lodges will be authorized on the Forest until expansion at existing resorts is complete under all alternatives and a determined need exists. Approval of future expansions and improvements at existing resorts will be addressed on a case-by-case basis through the administrative permit process.

The number of **recreation residences** does not vary by alternative. At the current time, no other uses have been identified for the areas occupied under permit for recreation residences. Future use determination would be to continue to permit recreation residences and work in partnership with permit holders in all alternatives until conditions change or the appropriate environmental analysis shows a higher need for these lands.

In accordance with national direction, the Bighorn National Forest conducted a Forest Plan Consistency Review (CR) after the release of the Draft Plan and Draft EIS. This review is the first administrative step in a process to determine whether recreation residence uses within a tract may continue for another 20 years following the expiration of the current term permits. Presently, there are currently 265 recreation residences, including 82 summer home groups and 46 isolated tracts (lots not within a specific summer home group) on the Forest, and current permits will expire on December 31, 2008. The Consistency Review was completed in April 2005. It concluded that all recreation residence tracts on the Forest are consistent with the direction in the Revised Plan as of the date of the review, although some additional site inspections and mitigation may be necessary. Prior to expiration and a decision regarding the re-issuance of these permits, an environmental analysis will be conducted; that analysis is in progress.

Opportunities for outfitter/guides would not be affected based on the amount of acreage recommended for wilderness (MA 1.2) until such time as Congress acts affirmatively upon the Revised Plan's wilderness recommendations. Alternative C designates 126,575 acres as recommended wilderness. Alternative D-FEIS is the only other alternative recommending wilderness, with 33,857 acres (Rock Creek). Under Wyoming Law 23-2-401, nonresidents wishing to hunt in designated wilderness must be accompanied by either a licensed professional guide or a resident guide. However, since the allocation of Management Area 1.2 is only a recommendation to Congress (and not a designation per se), nonresidents would be able to hunt without being accompanied by a licensed professional guide or a resident guide. Should Congress eventually designate some or all of the MA 1.2 areas in Alternative C, Wyoming law would apply to any areas recommended for wilderness. For additional information regarding wilderness, see the Wilderness section of this chapter.

The designation of additional Research Natural Areas (RNAs) carries the potential to limit opportunities for the issuance of new **outfitter-guide** activities as permits for new outfitter guides in designated RNAs will not be issued. Numbers and acres of RNA designations by alternative are discussed later in this section. Should the Forest be determined to be occupied lynx habitat, winter outfitting opportunities (snowmobiling, etc.) could potentially be affected by lynx-related Revised Plan direction. These conservation measures would allow for amendment of winter recreation special use permits (outside of permitted ski areas) if it is determined that they promote snow compacting activities in lynx habitat. This effect would be similar across all alternatives.

Effects from Cave Management on Dispersed Recreation: Cave resources are considered non-renewable because of the unique geologic and hydrologic conditions under which they formed, the time it took them to develop, and the sensitivity of microclimates within caves. The Federal Cave Resources Protection Act of 1988 requires the protection of significant caves found on federal lands. Revised Plan direction may result in limitations on human access to caves in an attempt to protect cave resources. These effects would contribute to preserving recreational caving experiences into the future. Since protection of cave resources is mandated by law, these effects are common to all alternatives.

Effects from Oil and Gas: No new exploration is projected for the next decade based on past history (1 dry well in the past 30 years). This projection estimate may be revised at a later date pending release of the Reasonably Foreseeable Development (RFD) report by the Bureau of Land Management.

Effects from Livestock Grazing: Recreation would be affected similarly by livestock grazing in all alternatives since livestock grazing does not vary by alternative. Signs of livestock grazing, such as the presence of cows or sheep, fences, driveways, stock tanks and ponds, cropped forage, trampled vegetation or manure may adversely affect the recreational experience.

Conflicts can occur between visitors, their dogs, cattle herds, bands of sheep, and the dogs used to control herds. These concerns are most often expressed by recreationists who prefer a livestock-free experience. In some cases, active allotments or recently vacated

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areas aren't always obvious. On the other hand, there are also those Forest visitors, particularly nonresident travelers of the U.S. highways, who are intrigued by the sight of the "old west" style of ranching in action.

Effects from Cultural Resource Management: Special Interest Areas (MA 2.1) are designated for historical values. Within these areas, motorized and mechanized travel are prohibited where necessary to protect the values for which the individual area was proposed or established. Recreation use is allowed which emphasizes interpretation, education, and inspiration when it does not threaten the values for which the area was identified. The adopted ROS class is either semi-primitive nonmotorized or semi-primitive motorized, depending on the specific area and the desired management outcome. New roads or trails are allowed only when they are consistent with the values of the SIA. The following table shows SIA designation by alternative.

Table 3-118. Management Area 2.1 designation by alternative.

	Alt A	Alt B	Alt C	Alt D-DEIS	Alt D-FEIS	Alt E
Total Acres	89	20,004	17,024	0	0	0

In addition to MA 2.1, designation of the Medicine Wheel Special Interest Area also varies by alternative. This area is referred to as Management Area 3.1 in Alternatives A, B, C, D-DEIS, and E; in Alternative D-FEIS it is Management Area MW. Within MA 3.1/MW, certain recreation uses are allowed as stipulated within the Historic Preservation Plan for Medicine Wheel National Historic Landmark and Vicinity (HPP) provided they do not threaten the integrity of the site as a sacred site and a nationally important traditional cultural property. The area is managed solely as a day-use site and camping and the use of campfires are prohibited by special order. In the immediate vicinity of the Medicine Wheel, management emphasis is strictly to protect the traditional cultural values of the area. In Alternative A, the MA 3.1/MW is 61 acres. In Alternatives B, C, D-DEIS, D-FEIS, and E, it is slightly less than 21,000 acres.

Effects from Research Natural Areas (RNAs): Research Natural Area (RNA) designation can affect the scope of available recreation opportunities for that designated area. RNA designation prohibits motorized recreation aside from snowmachine travel on designated trails. RNA designation also prohibits the construction of new roads and trails, except when they are necessary to correct resource damage occurring from existing travelways or unless needed for administrative purposes consistent with RNA establishment objectives. Permits for new outfitter guides in RNAs will not be issued in the future. RNA designations by alternative are described below.

Table 3-119. Research Natural Area designation by alternative.

	Alt D-FEIS	Alt B	Alt D-DEIS	Alt C	Alt A	Alt E
# areas	4	6	6	6	2*	2
Total acres	6,574	21,190	21,190	21,188	1,618	1,618

* = current number of RNAs from 1985 Plan

In Alternatives B, C, and D-DEIS, a negligible effect on motorized system routes will occur. Approximately 1.25 miles of Trail 131 (Martini Loop), immediately northwest of the Bud Love Big Game Winter Range would be precluded from motorized use. However, since this short trail is entirely surrounded by nonmotorized system routes, it is currently inaccessible to motorized use. As a result, there is no actual loss of motorized trail opportunity. Investigations of historic travel maps indicate this trail was never intended to be a motorized trail. An error with a previous travel map resulted in it being shown as motorized.

Effects from Roadless Area / Wilderness Management: Roadless areas provide opportunities for primitive and semi-primitive (both motorized and nonmotorized) recreation. Wilderness areas (as well as wilderness recommendations) provide opportunities for primitive and semi-primitive nonmotorized recreation. The undeveloped condition of roadless areas creates the feeling of solitude and, in some instances, provides an experience similar to wilderness recreation, with additional opportunities for certain activities not allowed in wilderness. Provided the Management Area prescription is compatible, a motorized experience on existing system routes is an acceptable use in roadless areas on the Bighorn National Forest. It is not an allowed use within wilderness or recommended wilderness, however.

Alternative C has the most recommended acres (126,575) of wilderness; it places essentially all of the inventories roadless areas into a Category 1 or 2 management area. Alternative D-FEIS includes a wilderness recommendation (MA 1.2) for the 33,857 acre Rock Creek area. Alternatives A, B, D-DEIS, and E do not recommend any additional wilderness. In Alternative C only, MA 1.2 designation will affect a small number of trails which are currently open to motorized travel, as shown below (since motorized travel would be prohibited in MA 1.2):

Table 3-120. Motorized trails located within Alternative C's recommended wilderness management areas:

Trail #	Name	Mileage	Trail #	Name	Mileage
8	Freezeout	3.2	96	Boyd Ridge	1.8
52	Tillet's Hole	1.6	146	Pumpkin	5
54	Railroad Springs	1.25	180	Medicine Lodge	1.6
Total trail miles affected 14.45					

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In Alternative D-FEIS, the 1.25 mile Martini Loop Trail (Trail #131) would be located within the Rock Creek recommended wilderness. This trail is shown on the current travel map as open to motorized travel, however this is not actually a motorized trail. All of the travel maps up until the current map have shown it as a nonmotorized trail which is indicative of an error on the travel map, further evidenced by the fact that this trail is surrounded by nonmotorized trails and is inaccessible to motorized travel. As a result, there is no loss of motorized trail opportunity. The Forest will address this mapping error in the new travel map due to be printed in 2006. Alternative E assigns the most roadless acres to management areas that allow road building, followed by Alternatives A, D-DEIS, D-FEIS, B and C.

Effects from Timber Management: Clearcutting and road building can create changes in the landscape, resulting in shifts from the less developed end of the ROS spectrum to a roaded modified setting. Studies have generally found that, in terms of aesthetic preferences for forested landscapes, mature forests are preferred over young ones, natural looking stands over those with obvious human impact, and partial-cutting techniques over clearcuts (Ribe 1989).

These long-term effects of timber management can make it more difficult for recreationists who seeking out a more unroaded, remote, challenging experience. Alternative E allocates the most Forest acreage to timber production, followed by A, D-FEIS, D-DEIS, B and C. In addition to the additional access provided by roads, large open areas that are created can encourage off-road/trail traffic encroachment into previously unavailable areas, resulting in an increased number of nonsystem, user-created trails although sale roads will not remain open to the public in most cases. Average annual road construction (over a 50-year period) associated with timber management are shown in the table below:

Table 3-121. Average annual new timber road construction (over a 50-year period).

	Alternative					
	E	A	D-DEIS	B	D-FEIS	C
50-year annual average (miles)	2.1	1.7	1.2	0.8	0.6	0.4

The numbers shown above represent an average, with higher and lower amounts possible in individual years. These roads will be built to level 2 standards but it is likely that the vast majority of them will be closed to the public after completion of harvest. Given that most timber routes would not be open to public motorized summer use, logging should not result in a quantifiable change in the supply of dispersed camping opportunities. Even though the road may be closed, there are still effects to the recreation setting due to the creation of a roaded environment. Though the road may be closed, it allows for easier travel into formerly unroaded areas, and a shift from a primitive or semi-primitive setting to a roaded (more specifically, roaded modified) setting. The effect is a loss of a sense of challenge and risk associated with an unroaded setting and the potential for displacement of recreationists seeking an unroaded setting to other areas, as well as the potential for

concentration of users who seek unroaded settings into the remaining unroaded areas on the Forest. This effect would be greatest in Alternatives A and E.

Short-term effects include increased noise and dust levels, visually altered landscapes (the presence of slash piles, etc.), the presence and use of roads constructed for timber sales, the potential for disrupted travel routes due to any necessary road closures, and conflicts and potential safety hazards associated with logging trucks on main roads.

In Alternatives A and E, approximately 12-15 miles of road construction may be needed to access timber in the Piney Creek /Rock Creek area. Given the length of the roads needed, there is the potential that they could remain open to public use as a level 3 road. This could create additional dispersed camping opportunities and help address existing dispersed camping demands. This potential road construction would be addressed at the project level.

Under all alternatives, trails that have been identified for retention as part of the designated travelway system during other resource projects such as timber sales will be protected or enhanced through a forestwide standard. To maintain the desired recreation experience, the Forest will relocate, reconstruct, or otherwise keep functional those trails disrupted by other management activities.

Effects from Fire and Fuels Management: Under all alternatives, wildfire could alter recreational settings, especially at developed sites. Wildfire may alter the short-term and long-term (depending on intensity) appearance of primitive and semi-primitive settings, but it is compatible with their characteristic trait of being a natural-appearing environment.

Historically, humans have been responsible for approximately half the wildfires on the Bighorn National Forest. Wildfires, or the potential threat of wildfires, can result in restrictions or outright closures of the Forest, or portions of the Forest, and accompanying loss of recreation opportunities. Wildfires also have direct impacts to developed facilities such as campgrounds and recreation residences (burned structures, damage to drinking water sources, creation of hazard trees, damage to roads providing access to these sites) as well as more dispersed recreation assets such as trails (short-term closures, burned improvements such as waterbars and signage) (Chavez and McCollum, 2004).

Effects from Elk Security: Elk security areas are seen as a critical factor in retaining elk on the National Forest during hunting season, contributing to hunter success and satisfaction. Elk security areas are defined as those which met the necessary habitat criteria (as described in the biodiversity section of this Chapter) as well as were located greater than ½ mile from any open road or motorized trail. While elk are considered to be an indicator species, other wildlife could also benefit from the presence of elk security areas. This coincides with a growing concern that public hunting opportunities are suffering from reduced access to certain areas of the Forest as private landowners close their land to the public. Concerns have been expressed by the public that elk are escaping to inaccessible private land in advance of hunting season, and there is the potential that these elk security areas could help to alleviate this concern.

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Elk security areas provide an opportunity to view big game animals in a relatively undisturbed setting. However, the nature of an elk security area is partly based on the premise that access to the area is more difficult to the public, and as a result, is likely to not be as easily accessed as other parts of the Forest by wildlife viewers who do not venture far from their vehicles. Management for retention of elk security during vegetation management projects and timber sales under the Revised Plan could result in site-specific decisions to close motorized routes to maintain a desired level of elk security. This can generate significant public controversy among groups and individuals who oppose closure of motorized routes. Travel management decisions would need to take address elk security as an issue with regard to miles of system roads and motorized trails in an area.

Effects from Management Area Allocations (MA 5.4 and MA 5.41): Management Area 5.4 (Plant and Wildlife Habitat Forest Products), found only in Alternatives D-FEIS and E, has several guidelines with regards to route density and stream crossings. An open summer motorized route density of 1.0 mile per square mile should not be exceeded (calculated within the management area). In addition, for roaded and motorized trail stream crossings, an average density of 0.5 crossings per square mile (calculated within the management area) should not be exceeded. MA 5.4 acreage by alternative is shown in the following table.

Table 3-122. Management Area 5.4 acreage by alternative.

	Alt E	Alt D-FEIS	Alt A	Alt B	Alt C	Alt D-DEIS
Acres	134,374	59,275	0	0	0	0

None of the 5.4 management areas exceeds the 1.0 mile of open motorized nonwinter route per square mile threshold. Under Alternative D-FEIS, there are 5 areas allocated to MA 5.4. Of these, 2 areas (Babione Creek and Doyle Creek) exceed the stream crossing density guideline. At the project level, open motorized stream crossing densities would need to be reduced in these two areas. Additional discussion regarding both of these guidelines can be found in the wildlife and aquatics sections of this document respectively.

In winter, the need for protecting critical big game winter ranges from disturbance by motorized uses can directly affect winter recreation opportunities. Under a guideline for Management Area 5.41 (Deer and Elk Winter Range) the Forest would discourage or prohibit human activity through project-level decisions as determined necessary in these areas during the winter and spring periods when the area is occupied by deer and elk.

In addition to prohibitions on winter snowmobile travel, in MA 5.41 (Deer and Elk Winter Range), special use-permitted activities are limited during the winter and spring periods. New development of roads, trails, and recreation facilities are discouraged. The amount of MA 5.41 by alternative is shown in the following table.

Table 3-123. MA 5.41 acreage by alternative.

	Alt D-FEIS	Alt E	Alt D-DEIS	Alt B	Alt A	Alt C
Acres	34,865	29,638	28,852	28,213	27,680	21,325

Cumulative Effects

The cumulative effects table at the beginning of this chapter includes the list of past, present and reasonably foreseeable future activities that were considered with regard to cumulative effects to recreation. The next 15 years are considered the time span for “reasonably foreseeable future” cumulative effects. The area considered with regard to cumulative effects consists largely of the Bighorn National Forest as well as the state of Wyoming, along with some consideration of trends and effects on a national scale.

Forestwide ROS Shift: Past project-level decisions (primarily timber management and road construction) on the Bighorn National Forest have resulted in a shift in forestwide Recreation Opportunity Spectrum (ROS) composition in many areas from the primitive and semi-primitive classes to the more developed classes (roaded modified and roaded natural ROS classes). This has been a long-term trend and one which is likely to continue, although to varying degrees based on the alternative chosen. This trend is particularly important because “reversibility,” or the concept of an area reverting from a more developed ROS setting to a less-developed one, is something which can be both time intensive (regrowth of trees) and expensive (removing evidence of roads).

As discussed in the general effects portion of this section, the existing forestwide ROS composition would experience the least amount of shift in Alternative C, followed by B, D-FEIS, D-DEIS, A, and E. In other words, A and E would see the greatest potential over the long-term, for loss of non-wilderness primitive and semi-primitive nonmotorized ROS acreage. This is primarily due to the an increased level of management activities (particularly timber management and associated roading) that would take place in these alternatives.

Off-trail Travel (“C areas”) – Past Actions: In 1989 there were about 200,000 acres open to other than snowmobile off-road motorized use. Decisions such as the closure of the Lost Fire area due to vegetation, soil, and water quality impacts caused by off-road summer travel, and the Little Goose area closure reduced that opportunity to 140,000 acres as of August 1, 1997.

Further area closure resulted when the Caribou Timber sale took place in 1998. 18,000 additional acres of “C area” were converted to “A area” requiring that motorized travelers remain on system roads and trails, other than snowmobiles on snow. This particular action was proposed as a mitigation to the thinning of the forested stands by the timber harvest, which had the potential to open up the stands enough to invite and increase the amount of off-road travel.

The Tongue District of the Bighorn National Forest signed a decision notice in 1997 for the Little Goose/Park Reservoir Environmental Assessment that changed cross-country

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travel on 60,000 acres to travel on roads and trails. The decision also identified miles of trail for motorized and nonmotorized use to separate conflicts from the guest ranch providing trail rides from an area that receives a substantial amount of ATV and motorcycle use. This project successfully collaborated with users and stakeholders.

The Medicine Wheel/Paintrock District of the Bighorn National Forest signed a decision notice in 2002 for the Battle Park Environmental Assessment. This decision more effectively separated nonmotorized and motorized trail users by designating trail use.

In March, 2005 the Powder River Ranger District signed a decision which changed previously permissible cross-country travel on nearly 70,000 acres to the Clear Creek and Crazy Woman “C areas” areas to travel on roads and trails and placed an emphasis on loop routes. During the same month, the Tongue Ranger District signed a decision which will provide 69 miles of open system roads and 17 miles of open system trails while decommissioning 55 miles of road and 4 miles of trail, and closing 13 mile of road and 1 mile of trail. All nonsystem routes were decommissioned and cross-country motorized travel (i.e. travel off of system routes) was prohibited.

In addition to the project level decisions that are taking place separate of forest planning, the “C areas” are being addressed in a forestwide standard in all alternatives which will prohibit off-route motorized travel. As a result, no variance in this effect is anticipated. The Medicine Wheel / Paintrock Ranger District is in the process of initiating travel management planning for the Hunt Mountain area “C area” in order to identify and designate an appropriate travel network for the area and it is anticipated that a decision will be made in 2006 for this area.

Coalbed Methane Development Implications: A group of oil and gas companies notified the Bureau of Land Management (BLM) and U.S. Forest Service of their intent to develop additional coal bed methane (CBM) resources in Wyoming’s Powder River Basin. The Proposed Action, as analyzed by the BLM in their Final Environmental Impact Statement, includes drilling, completing, operating and reclaiming almost 39,400 new CBM wells and constructing various ancillary facilities needed to support the new wells. The Proposed Action would occur in a project area of almost 8,000,000 acres. Drilling was scheduled to begin in 2003 and continue for 10 years.

In its January 2003 Final Environmental Impact Statement regarding the Powder River Basin Oil and Gas Project, the BLM’s Wyoming State Office arrived at several conclusions with regard to cumulative effects that are pertinent to consider within the framework of recreation implications for the Bighorn National Forest.

Population: BLM 2003 FEIS – “The project is expected to result in significant short-term effects to local populations. Assuming the population directly corresponds to workers associated with the project, the population in the region would peak in 2007 and then gradually decrease. It is assumed that most existing full-time workers would be recruited from communities within the Project Area (all or parts of Campbell, Converse, Johnson and Sheridan Counties) and that construction employment and contractors would be available in the region. To the extent that additional non-local contractors or permanent employees are needed, they may relocate to the area for a limited period (2 to 5 years)

during the major construction phase of the project...Up to 2,660 workers would be required during peak employment, in addition to the existing 2,943 workers in the region. Assuming each worker brings one person to the region, the population would increase by 5,320 in the peak year (2007), which would result in a 7 percent incremental increase in population between 2000 and 2007 from the project. After 2007, the population associated with the project would be expected to gradually decrease. During the short term, this increase in population will be noticeable in some communities and could result in hardships to the local governments, if adequate planning has or does not occur. However, in the long term, the project will not have significant long-term effects to local populations.” (BLM 2003).

This increase in regional population of approximately 7% will likely be comprised of a younger demographic composition with a fair amount of disposable income given the \$40,000 average annual income associated with CBM activities, upon which the 2003 BLM FEIS bases its economic assumptions. This younger (i.e. working age), financially robust demographic can be expected to place a high level of importance on outdoor recreation (Cordell and Overdevest 2001). Based on this, as well as the proximity of the Bighorn National Forest to the CBM Project Area, recreational use on the Forest is likely to increase as a result of CBM development in the coming years. It is difficult to predict exactly how increased local population will affect visitation on the Forest, but typically, as local populations increase, so too does forest visitation.

Wyoming State ORV program: As of January 1, 2002, all ORVs (ATVs, dirt bikes, and other unlicensed ORVs) are required to display a Wyoming ORV permit while operating on public lands and other designated trails and areas, mirroring the current snowmobile registration requirements. Just as snowmobile use has increased dramatically in the 1990s, ORV use will likely continue to increase, aided by an increase in information and advertising by the State Division of Tourism.

Potential adverse effects that could be anticipated as a result of greater information/promotion include additional users at trailhead facilities as well as a higher number of encounters on open roads and trails among users. Potentially positive effects that could be anticipated include additional funds from the State of Wyoming to benefit the trail system on the Bighorn National Forest in the form of signage, enhanced education and enforcement initiatives, and trail construction, reconstruction, or other trail-related improvements.

Management of Yellowstone Snowmobiling Opportunities: On November 4, 2004, the National Park Service (NPS) approved a Finding of No Significant Impact (FONSI) for the Temporary Winter Use Plans and Environmental Assessment for Winter Use in Yellowstone and Grand Teton National Parks and the John D. Rockefeller, Jr., Memorial Parkway. The Final Rule implementing this decision was published in the Federal Register on November 10, 2004.

This decision allows 720 snowmobiles per day in Yellowstone, all commercially guided. In Grand Teton National Park and the John D. Rockefeller, Jr., Memorial Parkway, 140 snowmobiles would be allowed. With minor exceptions, all snowmobiles would be required to meet NPS best available technology (BAT) requirements. The plan will be in

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effect for three winters, allowing snowmobile and snowcoach use through the winter of 2006-2007. The temporary winter use management plan ensures that resources are protected, gives visitors, employees and residents of the park's gateway communities the information they want and need to plan for the near term, and will help minimize economic impacts on gateway communities.

Preparation of this plan will also allow the NPS to complete a long-term analysis of the environmental impacts of winter use in the parks. The NPS expects that this long-term analysis will culminate with a permanent decision about winter use in the parks.

Yellowstone National Park is a premier winter recreation destination. While any change in the Park's snowmobiling opportunities could potentially affect winter recreation on the Bighorn National Forest, it is not likely to be dramatic; there may be a slight increase due to displaced users.

A 2000-2001 study by the University of Wyoming determined that Yellowstone National Park was not a primary destination for most nonresident snowmobilers, accounting for only 3.5% of total trips in 2000. For nonresidents, the most popular new trails to visit in Wyoming were the Snowy Range (31%), the Northern Big Horns (17 percent), Togwotee (17%), Dubois (15%), Gros Ventre (10%), and Yellowstone National Park (9%). The primary reason given for trying a new trail was to experience a new area (87%). Lack of crowds was not a major determinant in choosing a new trail system, with only 20% of nonresidents indicating that the reason for trying a new trail was that it was less crowded (McManus et al. 2001).

The influx of additional snowmobilers (3.5% of nonresidents) that would be displaced to other Forests would be relatively small. The primary basis for this conclusion is that the typical snowmobile clientele of Yellowstone is somewhat different from that of the Bighorn National Forest. The Big Horn Mountains offer the challenge of deep powder and opportunities to ride on ungroomed terrain. Snowmobile travel in Yellowstone is restricted to designated snow routes.

A slight variance in the ability to accommodate additional snowmobile demand exists among alternative in terms of the available acreage that is open to snowmachine travel. The most Forest acres would be open to snowmachine travel in Alternatives A and E, followed (in order) by Alternatives D-DEIS, D-FEIS, B, and C.

BLM proposed trail projects on western boundary of Bighorn National Forest: The BLM is planning to implement two trail maintenance and one trailhead construction projects on the west face of the Bighorns on BLM-managed land abutting up to the National Forest. They will involve the Cottonwood Creek trail and Pete's Canyon trail. A trailhead with camping sites will be built at the mouth of Cottonwood Canyon. The trails will remain nonmotorized use. Possible effects include improved ease of public access to the northwest portion of the Bighorn National Forest as well as the need for placement of gates or cattle guards at the National Forest boundary fence. This is projected to occur regardless of alternative.

The Future of National Forest Recreation Management: A number of recent trends are having a significant effect on National Forest recreation opportunities. Federal budgets are being reduced and are projected to continue declining. The same trend is projected for the size of the federal work force. Therefore, the number of Forest Service recreation professionals available to deliver good quality recreation products and services has fallen. The result is a loss of technical expertise when demand is dramatically increasing. Consequently, the Forest Service is finding it difficult to maintain the level of visitor services offered in the past, and the backlog in maintenance of recreation facilities has increased (Betz, et al, 1999).

In light of this, the importance of developing effective working relationships with volunteer groups cannot be overstated, particularly with regard to trail maintenance efforts on the Bighorn National Forest.

Volunteer groups (Backcountry horsemen, hiking clubs, motorized clubs, etc.) can provide a critical source of human capital to assist the Bighorn National Forest in accomplishing trail maintenance goals. In addition, the State of Wyoming State Trail Crew, funded through a Recreational Trails Program (RTP) grant as well as Wyoming Snowmobile and ORV funds, is available to perform maintenance, rehabilitation and development work.

The above partnership options/strategies mesh well with the 2001 Forest Service Recreation Agenda:

“Continuing to support existing and establishing new professionally managed partnerships and intergovernmental cooperative efforts are a significant means to accomplish the recreation job.”

These realities will affect the Bighorn National Forest to differing levels based on the alternative chosen. Given that recreation budget levels would be slightly less in Alternatives A and E (due to the emphasis placed on timber management and the need to fund a higher level of activity in that program in those alternatives), it would be more difficult to maintain the same level of services as in Alternatives B, D-DEIS, D-FEIS and C (which would fund the recreation program at the current level. As a result, this effect would be more exaggerated in alternatives A and E. Alternatives B, C, D-DEIS and D-FEIS would likely fund the developed recreation budget at or near current proportionate levels.

In conclusion, several primary aspects of recreation management on the Forest can be examined in terms of cumulative effects. The following table provides a summary of the relative impacts of alternatives on recreation opportunities on the Forest. The categories are ranked in order of existing and potential impact to recreation opportunities on the Forest.

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Table 3-124. Overview of recreation-related cumulative impacts.

Recreation Opportunity	Less Impact ← Relative Impact → More Impact to recreation opportunities					
Nonwinter motorized recreation opportunities	E, A (similar)		D-DEIS	D-FEIS	B	C
Nonwinter nonmotorized recreation opportunities	C	B	D-FEIS	D-DEIS	A	E
Developed recreation opportunities	B, C, D-DEIS, D-FEIS (all similar) (No impact based on Plan decision)				A, E (similar) (Slight impact)	
Winter motorized recreation opportunities	A, E (similar)		D-DEIS, D-FEIS (similar)		B	C
Winter nonmotorized recreation opportunities	C	D-FEIS	B	D-FEIS	A, E (similar)	

Research Natural Areas

Introduction

Research Natural Areas (RNAs) are selected to provide a spectrum of relatively undisturbed areas representing important natural ecosystems and environments. RNAs do the following (Forest Service Manual 4063.02):

- ◆ Preserve a wide spectrum of pristine areas that represent important forest, shrubland, grassland, alpine, aquatic, geological and similar natural situations that have special or unique characteristics.
- ◆ Preserve and maintain genetic diversity.
- ◆ Protect against serious environmental disruptions.
- ◆ Serve as reference areas for the study of succession.
- ◆ Provide on-site and extension educational activities.
- ◆ Serve as baseline areas for measuring long-term ecological changes.
- ◆ Serve as control areas for comparing results from manipulative research.
- ◆ Monitor effects of resource management techniques and practices.

Areas that had extensive, relatively undisturbed plant communities were identified as potential Research Natural Areas for the Bighorn National Forest plan revision. The Forest contracted with the Wyoming Natural Diversity Database (WYNDD) to inventory potential RNA candidates. The WYNDD inventory reports of each potential RNA include detailed descriptions, distinguishing features, acreage by vegetation cover type, and the compatibility of past and present human use with the RNA criteria.

Criteria

The following criteria were used in selecting potential RNAs:

- ◆ Quality: How well a site represents the targeted ecosystem type or protected biodiversity elements.
- ◆ Condition: How much the site has been degraded or altered from natural or optimal conditions.
- ◆ Viability: The likelihood of long-term survival for the ecosystem and its protected biodiversity.
- ◆ Defensibility: Extent to which the ecosystem and biodiversity elements can be protected from extrinsic human factors.

Legal and Administrative Framework

36 CFR 219.25 (1982 regulations) - “Forest planning shall provide for the establishment of Research Natural Areas (RNAs). Planning shall make provision for the identification of important forest, shrubland, grassland, alpine, aquatic and geologic types that have special or unique characteristics of scientific interest and importance that are needed to complete the national network of RNAs.”

On July 19, 1993, the Chief of the Forest Service issued a national strategy for recognizing the expanding role of RNAs in ecosystem management. Giving Regional Foresters the authority to designate RNAs was an important part of this strategy. On November 1, 1993, the Rocky Mountain Regional Forester and the Director of the Rocky Mountain Forest and Range Experiment Station directed forests in the region to expand the RNA system. The Regional Forester and the Director asked the forests to make a concentrated effort to identify potential RNAs in their forest plan revision processes.

Forest Service Manual, Title 4063 - provides specific direction concerning establishment and management of RNAs.

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Beginning in about the mid-1990s, the Bighorn National Forest considered adding up to eleven potential RNAs during this revision. The following two tables summarize a few key characteristics of the existing and potential RNAs. The complete WYNDD inventories for each potential RNA are approximately 50 or more pages long, and are available in the project record. The potential RNAs listed in bold (in the second table) are considered in one or more Revised Plan alternatives; the other potential RNAs are not included in any alternative considered in detail. The RNAs included in alternatives considered in detail are those that best met the objectives of the RNA program and best met the four RNA criteria shown above. RNA maps are on file in the administrative record.

Table 3-125. Selected features of existing Bighorn National Forest Research Natural Areas.

Name	Acres	Date Established	Special Features
Bull Elk Park	720	1952	201 acres of disjunct Palouse Prairie Climax; <i>Agropyron-Festuca</i> association. Remainder of area is primarily lodgepole pine montane forests.
Shell Canyon	729	1987	Primary reason for establishment is Rocky Mountain juniper community. Most other sites have been seriously disturbed, and Shell is considered to be in good condition.

Table 3-126. Potential RNAs considered for the Bighorn National Forest.

Potential RNAs	Acres	Major Cover Types	Soil Substrate
Lake McClain	2,302 ¹⁶	Subalpine/alpine, Lodgepole pine, Spruce-fir	Granite
Leigh Canyon	1,200	Douglas-fir, Cottonwood, Shrub/sagebrush	Sedimentary
Mann Creek	7,000	Douglas-fir, Grass, Ponderosa pine, Limber pine, Shrub	Sedimentary
Pheasant Creek	9,090	Lodgepole/Grouse whortleberry	Granite (<10% Sed.)
Pete's Hole	2,770	Spruce-fir, Sagebrush, Douglas-fir, Limber pine	>80% Sedimentary, <20% Granite
Dry Fork	10,190	Douglas-fir, Grass, Sagebrush	Sedimentary
Elephant Head	9,660	Grass, Spruce-fir, Sagebrush, Rocky Mountain juniper, Cottonwood	Sedimentary
Devil's Canyon	~6,000	Spruce-fir, Douglas-fir, Limber pine, Aspen, Grass, Sagebrush	75% Sedimentary, 25% Granite
Tongue River	5,660	Douglas-fir, Grass, Ponderosa pine, Cottonwood, Limber pine	80% Sedimentary, 20% Granite
Crazy Woman	1,580	Lodgepole pine, Ponderosa pine, Cottonwood, Shrub	50% each
Poison Creek	2,330	Lodgepole pine, Grass, Aspen	85% Granite, 15% Sedimentary

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General Effects

Alternatives A, E, and No Action maintain only the acreage of the existing RNAs – Bull Elk Park and Shell Canyon. Alternatives B, C, and D-DEIS, with about 21,021 acres, would provide for the most existing and proposed RNAs. The rationale for selecting the same four RNAs in Alternatives B, C, and D-DEIS is that those four areas represent the primary vegetation and substrate types that occur on the Bighorn National Forest, thus providing for a coarse filter baseline to use as an RNA system. For D-FEIS, Lake McClain is not included because of conflicts with existing snowmobiling and grazing uses.

¹⁶ The ecological evaluation for Lake McClain included about 6,200 acres within the Cloud Peak Wilderness, but the portion of the potential RNA within the Wilderness is not recommended in the Revised Plan for RNA designation.

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Pheasant Creek is not included because it is within a recommended wilderness area. While there are RNAs within wilderness areas, the objectives for these areas are not the same. For example, wilderness designation implies some degree of public recreation use as an objective. On the other hand, RNA objectives allow for non-degrading recreation use to occur, but it is not an objective. The following table summarizes the proposed RNA acres by alternative. 2.2 is the RNA Management Area.

Table 3-127. Approximate acres of RNAs by alternative.

Research Natural Area	No Action	Alt B	Alt D-DEIS	Alt C	Alt D-FEIS	Alt A	Alt E
Bull Elk Park	720	720	720	720	720	720	720
Shell Canyon	729	729	729	729	729	729	729
Lake McClain	0	2,302	2,302	2,302	0	0	0
Leigh Canyon ¹⁷	0	1,200	1,200	1,200	1,162	0	0
Mann Creek	0	7,000	7,000	7,000	3,795	0	0
Pheasant Creek	0	9,090	9,090	9,090	0	0	0
Total Acres of RNAs ¹⁸	1,449	21,021	21,021	21,021	6,406	1,449	1,449
Total Acres of Management Area 2.2 ¹⁹	NA	21,190	21,190	21,188	6,575	1,618	1,618

Source: Bighorn National Forest GIS database

When possible, the boundaries of each potential RNA were aligned with manageable, identifiable locations on the ground. Boundary changes were made to the Leigh Creek and Mann Creek RNAs between the Draft Plan and the final Revised Plan to insure there were no conflicts with the existing grazing systems and allotments. The canyon ecosystems remain intact after these adjustments. Under Alternative D-DEIS, Mann Creek RNA included an active horse allotment, which was excluded from the D-FEIS area.

Prior to the ecological evaluation for RNA suitability, areas were reviewed to determine if past or current activities, such as roads, logging or active grazing allotments, would

¹⁷ Ecological evaluation is labeled as “Tensleep Canyon”. However, Tensleep Canyon itself is not suitable due to the U.S. Highway, an old highway, exotic species, and cattle trailing.

¹⁸ The GIS mapped size of Management Area 2.2 for the Bull Elk Park and Shell Canyon RNAs totals 1,618 acres, which is an approximation of the actual acreage of 1,449 acres shown in the establishment records. This line shows the total proposed and existing RNA acreage using the establishment record estimated size for the two existing RNAs.

¹⁹ This line is the GIS calculated size of the 2.2 Management Area for each alternative. It differs from the preceding line by the 169-acre discrepancy between the establishment record estimated size of Bull Elk Park and Shell Canyon and the GIS mapped size of those areas.

conflict with potential RNA designation. Vacant allotments, or areas outside allotment boundaries, were favored for consideration of RNA designation to lessen the impacts on the Forest grazing program, and because there would be less impact from past activities. The size of each potential RNA was designed to maintain ecosystem processes and landscape scale natural disturbance patterns, where feasible.

Direct and Indirect Effects

The intent of RNAs is to provide for baseline ecological processes and systems. Humans are intervening in every ecosystem globally, so it is important to provide some representative areas that are close to ‘natural’ in order to make sustainability determinations on lands more actively managed. RNAs are managed to maintain natural and relatively pristine pre-settlement conditions, while allowing ecological processes to prevail with minimal human intervention. However, under some circumstances, deliberate manipulation may be utilized to maintain the ecosystem or unique features for which the RNA was established or to re-establish natural ecological processes. Vegetation, habitat, soil productivity, water quality and ecological processes are to be in a natural condition or in as close a natural condition as practicable. Heritage resources are generally protected by RNA designation since ground-disturbing activities are limited.

A variety of uses, including most nonmotorized recreation activities, are allowed in RNAs as long as the activity or uses do not become a threat to the values for which the RNA was proposed and as long as RNA management plan direction is followed.

Effects from Facilities Management: Buildings and developed recreation sites are prohibited, unless there are exceptional circumstances that do not threaten the values for which the RNA was proposed. No known adverse effects from facilities, or upon existing facilities, are expected in any of the alternatives.

Effects from Fire and Fuels Management: Human-caused wildfires would be controlled in all alternatives. Where excessive fuel build-up from past wildfire suppression threatens the RNA with uncharacteristic fire intensities, naturally occurring fires would be controlled.

The use of scheduled prescribed fire may be permitted to restore a natural fire regime or to reduce unnatural fuel loads in all alternatives dependent on the objectives for each of the proposed RNAs. Fire control techniques would be used that minimize ground disturbance. Natural barriers would be used to confine or contain fire where possible.

Effects from Fish and Wildlife Management: Habitat manipulation for wildlife is prohibited unless it is specifically needed to restore or maintain natural ecosystem conditions. Habitat manipulation is allowed if specifically designed for the protection of threatened, endangered, or sensitive species. No known adverse effects are expected from fish and wildlife management for any alternative.

Effects from Insect and Disease Management: Natural outbreaks of native insects and disease are allowed to proceed without intervention, unless they are a substantial threat to important resources inside or outside the RNA boundary. Control methods would be

designed to minimize disturbance. No known adverse effects are expected from insect and disease management in any alternative.

Effects from Oil, Gas, and Minerals Management: Oil and gas leasing is allowed however, no ground disturbing activities are permitted within the boundaries of the RNA. Protecting recommended Research Natural Areas to maintain their consideration for designation would impact oil and gas exploration in proportion to the number of acres where surface occupancy is prohibited. Since there has been no oil and gas activity on the Bighorn National Forest in at least twenty years, there is expected to be no impact to oil and gas leasing from the designation of RNAs under any alternative.

When withdrawal from locatable mineral entry is necessary to protect the values for which the area was designated, a request for withdrawal from mineral entry will be in conformance with Section 204 of the Federal Land Policy and Management Act of 1976 (PL 94-576).

Extraction of salable mineral (sand gravel, hard rock for crushing, and landscape materials) would not be allowed in RNAs.

Effects from Livestock Grazing and Big Game Use : The Mann Creek and Leigh Creek RNAs included in Alternatives B, C, and D-DEIS have small areas of grazing at the edge of the mapped RNAs, and there is an active horse allotment in the West Fork of the Little Bighorn in the Mann Creek RNA. These areas were excluded in D-FEIS. The use of grazing as a management tool, on an incidental or infrequent basis, may be needed to achieve rangeland vegetation management objectives over all or a part of the area. However, it is anticipated that this would rarely, if ever, be implemented. The management plan for each RNA will detail what level of livestock use is provided for in that area.

The only change to current grazing practices anticipated is in the potential Lake McClain RNA. Currently, that is a vacant allotment, but it is utilized most years by adjacent sheep permittees in order to reduce the grazing duration on the permitted allotment. Under Alternatives B, C, and D-DEIS, the permittee would not be allowed to graze within the RNA boundary. There would be no impact on the current grazing use under Alternatives A, D-FEIS, and E.

Effects from Recreation Management: The Forest Service would not actively advertise RNAs as destinations for recreation use. However, existing non-vehicular recreation use would be allowed as long as the use does not pose a threat to the values for which the RNA was proposed. Current levels of horseback riding, hunting, hiking, fishing, camping, and related low-impact uses by the public would be allowed to continue. If resource degradation develops from increased use, the public would be encouraged to shift use to other, less impacted areas or administrative closures might be imposed.

Trails that exist prior to RNA designation are allowed for recreation, scientific, or educational access, except when they are a threat to the values for which the RNA was proposed. The construction of new trails is prohibited except when necessary to correct resource damage occurring from existing trails.

Motorized use is not allowed in RNAs, unless necessary for research or authorized administrative access. Physically challenged individuals who require motorized transportation will not be able to access these public lands.

After the Draft EIS was released, it was learned that snowmobilers access the western portion of the Lake McClain RNA from the groomed snowmobile trail that forms the boundary of the RNA. While this area could have been excluded from the RNA on a map, it was estimated that enforcement to keep snowmobiles out of the RNA would be difficult. This, along with the grazing issue, led to the Lake McClain RNA being dropped from D-FEIS.

Effects from Special-Use Management: Proposals for non-manipulative research would require approval of the Rocky Mountain Research Station Director and the applicable Forest Service authorized officer. Special use permits are required for the collection of all products as well as for many other types of commercial uses.

Effects from Threatened, Endangered, and Sensitive Species Management: Populations of federally listed threatened and endangered species located within any of the proposed RNAs will be protected according to stipulations under the Endangered Species Act and applicable forest-wide standards and guidelines. Sensitive species located within any of the proposed RNAs will be protected by applicable forest-wide standards and guidelines. The overall effect of RNA designation would provide additional protection for these species.

Effects from Timber Management: The proposed RNAs are not available for timber harvest. The following table lists the approximate amount of tentatively suitable acres in each of the RNAs. Although these lands are tentatively suitable, they would not be available for timber harvest if the RNAs were established.

Table 3-128. Summary of tentatively suitable timber acres by RNA.

Proposed RNA	Total Acres Tentatively Suitable Alt. B, C, D-DEIS	Total Acres Tentatively Suitable D-FEIS
Lake McClain	0	NA
Leigh Canyon ²⁰	87	67
Mann Creek	181	6
Pheasant Creek	5,299	NA
Total	5,567	73

Source: Bighorn National Forest GIS database

²⁰ Ecological evaluation is labeled as "Tensleep Canyon". However, Tensleep Canyon itself is not suitable, due to highway, old highway, exotic species, and cattle trailing.

Effects from Travel Management and Motorized Use: New road construction in RNAs would be prohibited. Existing roads are restricted from motorized use or decommissioned except when needed for necessary scientific, educational, or administrative purposes. Unclassified roads or trails (routes not on the Bighorn National Forest transportation system) within proposed RNAs would be decommissioned, although there are not believed to be any in the RNAs proposed under Alternatives B, C, D-DEIS, and D-FEIS

Effects from Wilderness Management: The ecological evaluation for Lake McClain included part of the Cloud Peak Wilderness. In D-FEIS, the Pheasant Creek RNA was allocated to a Recommended Wilderness Management Area. In order to eliminate the management complexity of having two important management objectives upon the area, it was decided in the final boundary determination of the Lake McClain RNA, and in D-FEIS for Pheasant Creek, to exclude the portion within the wilderness from RNA designation. The ID team felt the RNA values could be protected in those areas by the wilderness designation. Therefore, there is no effect, either to the RNA management or to wilderness management, caused by the designation of RNAs.

Effects of the Changes to the RNA system between D-DEIS and D-FEIS: D-DEIS includes 4 potential RNAs, while D-FEIS does not include Lake McClain and Pheasant Creek. Ecologically, there is considered to be no effect from this change, as areas dropped for the FEIS will receive the same general type of future management under this Revised Plan as they have had for several decades, and that management has resulted in high quality RNA conditions. The fact that Pheasant Creek and Lake McClain will continue under basically the same management during the next planning period suggests that they could be reconsidered for RNA designation at the next revision. A Rocky Mountain Research Station scientist felt that there may be less willingness by researchers to commit to long-term experiments in areas that do not have RNA designation, since management continuity could change over the course of time. However, since no experiments have ever been initiated on Bighorn National Forest RNAs, this might be considered a potential effect, at least for this planning period.

Cumulative Effects

Cumulative effects resulting from designation of RNAs would include present and future loss of commodity production (principally wood products and grazing products), although these effects are small due to the negligible level of these activities currently occurring. Recreational pursuits in the future could be affected by some of the limitations prescribed by RNA direction on types of recreation allowed and limits on accessibility, but only if future use levels substantially increase over present levels. Designation of RNAs will add to the acreage on the forest where ecological processes are largely unaffected by human influences.

Ecological assessments show that within the Bighorn Ecological Section, the Bighorn National Forest is a relatively distinct ecosystem – high-elevation, subalpine forests. The four RNAs considered in Alternatives B, C, and D-DEIS provide a representative baseline

of coarse filter forest types and geologic substrate. The D-FEIS RNAs are less representative because they both represent low-elevation, sedimentary substrate, ecosystems.

The life of the Revised Plan (10-15 years) was considered the future time horizon for this cumulative effects analysis. There are no reasonably foreseeable actions that would add to either the RNA system or the Bureau of Land Management's system of Areas of Critical Environmental Concern (ACEC), which are approximately equivalent to RNAs. For this analysis, draft BLM Resource Management Plans or draft revised forest plans were considered reasonably foreseeable actions.

The cumulative effects analysis area for the present status of RNAs and ACECs include:

- ◆ Gallatin and Custer National Forests, Montana.
- ◆ Shoshone and Medicine Bow National Forests, Wyoming.
- ◆ Thunder Basin National Grassland, Wyoming.
- ◆ BLM lands administered by the Buffalo Field Office (Powder River Basin – no ACECs in this area) and Worland District Office (Bighorn Basin), Wyoming.

The current list of RNAs assumes that RNAs recently recommended in the Medicine Bow National Forest and Thunder Basin National Grassland Revised Plans will be officially added to the RNA system. A complete list of RNAs by location, which includes total acreage, geologic substrate, and a summary description of the vegetation, is included in the project record. The only other RNA in the Big Horn Mountain ecological section is the Lost Water Canyon RNA in the Pryor Mountains. This RNA is ecologically similar to Mann Creek and Leigh Canyon since it is a low-elevation canyon on sedimentary substrates. The other RNAs on the other National Forests and Grasslands do not represent ecosystems found on the Bighorn National Forest.

The following table summarizes nearby RNAs and ACECs, in descending order of relevance to Bighorn National Forest ecosystems.

Table 3-129. Research Natural Areas and Areas of Critical Environmental Concern important to Bighorn National Forest ecosystems.

Forest or Area	Acres of RNA or ACEC	Bighorn Plan Alt. A, E	Bighorn Plan Alt. B, C, D-DEIS	Bighorn Plan Alt. D-FEIS
Big Horn Mountain Section				
Bighorn Revised Plan		1,449	21,021	6,406
Lost Water Canyon – Custer NF	3,645			
Cumulative Acres – Big Horn Mountain Section		5,094	24,666	10,051

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Yellowstone Highlands and Northern Parks and Ranges Sections			
Gallatin & Shoshone NFs	25,008		
Medicine Bow NF	14,272		
Cumulative Acres – Province Level	44,374	63,946	49,331
Powder River Basin Section			
Thunder Basin NG	1,220		
Cumulative Acres – Division Level	45,596	65,166	50,551
Bighorn Basin Section			
Worland District BLM	29,560		
Cumulative Acres of Nearby RNAs and ACECs	75,156	94,726	80,111

The ecoregions listed in the table have the following relationship (McNab and Avers, 1994):

Temperate Steppe Division

Great Plains – Palouse Dry Steppe Province

Powder River Basin Section – Thunder Basin NG

Temperate Steppe Regime Mountains

Southern Rocky Mountain Steppe – Open Woodland – Coniferous Forest – Alpine Meadow Province

Bighorn Mountains Section – Bighorn National Forest and Pryor Mountains

Yellowstone Highlands Section – Gallatin and Shoshone National Forest

Northern Parks and Ranges Section – Medicine Bow National Forest

Temperate Desert Division

Intermountain Semi-Desert and Desert Province

Bighorn Basin Section – Worland District BLM

Roadless Areas

Introduction

This section describes the inventory of roadless areas completed for forest plan revision. The inventory includes 25 areas totaling 494,703 acres or 45 percent of the Bighorn National Forest. The effects of alternatives on the inventoried roadless areas are discussed.

Legal and Administrative Framework

The Forest Service is required to inventory, evaluate, and consider all inventoried roadless areas for possible inclusion in the National Wilderness Preservation System. The Wilderness Act of 1964 (P.L. 88-577) gives the statutory definition of wilderness:

“A wilderness, in contrast with those areas where man and his own works dominate the landscape, is hereby recognized as an area where the earth and its community of life are untrammelled by man, where man himself is a visitor who does not remain. An area of wilderness is further defined in this Act, as an area of undeveloped federal land retaining its primeval character and influence, without permanent improvements of human habitation, which is protected and managed so as to preserve its natural conditions and which:

- ✧ Generally appears to have been affected primarily by the forces of nature, with the imprint of man’s work substantially unnoticeable.
- ✧ Has outstanding opportunities for solitude or a primitive and unconfined type of recreation.
- ✧ Has at least 5,000 acres of land or is of sufficient size as to make practicable its preservation and use in an unimpaired condition.
- ✧ May also contain ecological, geological, or other features of scientific, educational, or historical value.”

The 1984 Wyoming Wilderness Act (PL-98-550) designated the Cloud Peak Wilderness on the Bighorn National Forest. Section 401 of the act releases areas, not designated wilderness or wilderness study, for multiple use management and says the areas need not be managed to protect their suitability for wilderness designation prior to or during revision of the initial land management plans. The same section requires the Department of Agriculture to review wilderness options for the national forest lands again, when the forest management plans are revised. If areas are recommended for wilderness, during the revision of management plans, those areas are to be managed to protect their wilderness suitability. Areas not recommended need not be managed to protect their suitability for wilderness designation.

The Code of Federal Regulations at 36 CFR 219.17(a) states that “...roadless areas within the National Forest System shall be evaluated and considered for recommendation as potential wilderness during the forest planning process.”

Forest Service Manual (FSM) 1920 provides for an integrated land and resource management planning effort. FSM 1923.04c requires the Forest Supervisor to conduct necessary wilderness studies and prepare a study report/environmental impact statement, either as a part of the forest plan or as a separate study.

Forest Service Handbook (FSH) 1909.12.7.1 directs national forests to "...identify and inventory all roadless, undeveloped areas that satisfy the definition of wilderness found in section 2(c) of the 1964 Wilderness Act." It also describes capability, availability, and need assessments for inventoried roadless areas

Historical Summary

On September 3, 1964, the Wilderness Act (P.L. 88-577) established the National Wilderness Preservation System. It provides a management philosophy and direction for designated wilderness areas.

In 1970, the Forest Service evaluated all roadless and undeveloped areas in the National Forest System greater than 5,000 acres for the purpose of prioritizing areas with strong wilderness characteristics. This study, known as the Roadless Area Review and Evaluation (RARE), was halted after a legal challenge.

In 1977, the Forest Service embarked on another nationwide Roadless Area Review and Evaluation (RARE II) to identify roadless and undeveloped areas that were suitable for inclusion in the National Forest Wilderness Preservation System. The RARE II inventory was completed in 1979. It included 17 inventoried roadless areas and a total of 689,770 acres on the Bighorn National Forest.

In the late 1970s, the Bighorn National Forest began development of a land and resource management plan for the Forest, which included an evaluation of inventoried roadless areas. Volume II-Appendix M of the Draft Environmental Impact Statement for the Forest Plan containing roadless area information was completed and released to the public on August 8, 1984. The appendix inventoried and evaluated a total of 681,068 acres.

Congress passed the Wyoming Wilderness Act of October 30, 1984 (P.L. 98-550), designating the 189,039-acre Cloud Peak Wilderness. The Cloud Peak Wilderness designated by Congress included the Cloud Peak Primitive Area, the Seven Brothers area and some additional acreage contiguous with the primitive area. The act also released all remaining (non-wilderness) roadless areas for multiple use management. This action effectively ended further analysis of roadless areas in the 1985 forest planning process. However the act required review of wilderness options for the national forest lands again, during revision of forest management plans.

The Bighorn National Forest Land and Resource Management Plan (1985 Forest Plan) and Final Environmental Impact Statement and were completed and released with a Record of Decision dated October 4, 1985. The Wyoming Wilderness Act was recognized in the final 1985 Forest Plan, and all roadless areas outside of Cloud Peak Wilderness were allocated for non-wilderness management areas. Of the 623,014 roadless acres allocated for multiple use, about 587,000 acres were included in management areas allowing road

construction and reconstruction, and about 34,000 acres were included in wild river management areas that do not allow road construction and reconstruction.

The 1985 Forest Plan also included wild and scenic river management areas for portions of the current Little Bighorn and Tongue River roadless areas. A 1989 Wild and Scenic River Study Report and Final EIS on the Little Bighorn River recommended portions of the Little Bighorn River and the Dry Fork of the Little Bighorn for designation. No similar recommendation for designation was completed for the Tongue River. No areas were recommended for wilderness designation in the 1985 Forest Plan.

The Roadless Area Conservation Rule (36 CFR Part 295) was published January 12, 2001. The Final EIS for the Roadless Area Conservation Rule (RACR) published in November 2000 included a map of inventoried roadless areas based on the 1984 Bighorn Forest Plan DEIS – Appendix M.

The Roadless Area Conservation Rule - RACR or roadless rule - prohibits road construction and road reconstruction in inventoried roadless areas except:

- ◆ To protect health and safety in cases of imminent threat of flood, fire or other catastrophic event that, without intervention, would cause the loss of life or property.
- ◆ To conduct environmental clean up required by federal law.
- ◆ To allow for reserved or outstanding rights provided for by statute or treaty.
- ◆ To prevent irreparable resource damage by an existing road.
- ◆ To rectify existing hazardous road conditions.
- ◆ Where a road is part of a Federal Aid Highway project.
- ◆ Where a road is needed in conjunction with the continuation, extension, or renewal of a mineral lease on lands that are under lease, or for new leases issued immediately upon expiration of an existing lease.

The rule also prohibits cutting, sale, and removal of timber in inventoried roadless areas except:

- ◆ For the cutting, sale or removal of generally small diameter trees which maintains or improves roadless characteristics and:
 - ✧ To improve habitat for threatened, endangered, proposed, or sensitive species, or
 - ✧ To maintain or restore ecosystem composition and structure, such as reducing the risk of uncharacteristic wildfire effects.
- ◆ When incidental to the accomplishment of management activity not otherwise prohibited by this rule.

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- ◆ For personal or administrative use.
- ◆ Where roadless characteristics have been substantially altered in a portion of an inventoried roadless area due to construction of a classified road and subsequent timber harvest occurring after the area was designated an inventoried roadless area and prior to the publication date of this rule.

Litigation concerning the Roadless Rule began shortly after publication. The most recent judicial decision (July 14, 2003) was issued by the Judge Brimmer, United States Federal District Court, Wyoming. It permanently enjoins the implementation of the Roadless Rule nationwide. The decision has been appealed.

The Department of Agriculture concluded that revising the rule by providing a petitioning opportunity was an appropriate solution to address the challenges of roadless area management. The Department of Agriculture issued 36 CFR Subpart B--State Petitions for Inventoried Roadless Area Management on May 13, 2005. This new rule (36 CFR 294) establishes a petitioning process that provides Governors an opportunity to seek establishment of or adjustment to management requirements for National Forest System inventoried roadless areas within their States. The opportunity to submit state petitions is available for 18 months beginning May 13, 2005. 36 CFR 294.11 includes a revised definition:

- ◆ Inventoried Roadless Areas – Areas identified in a set of inventoried roadless area maps, contained in the Forest Service Roadless Area Conservation, Final Environmental Impact Statement, Volume 2, dated November 2000, and any subsequent update or revision of those maps through the land management planning process.

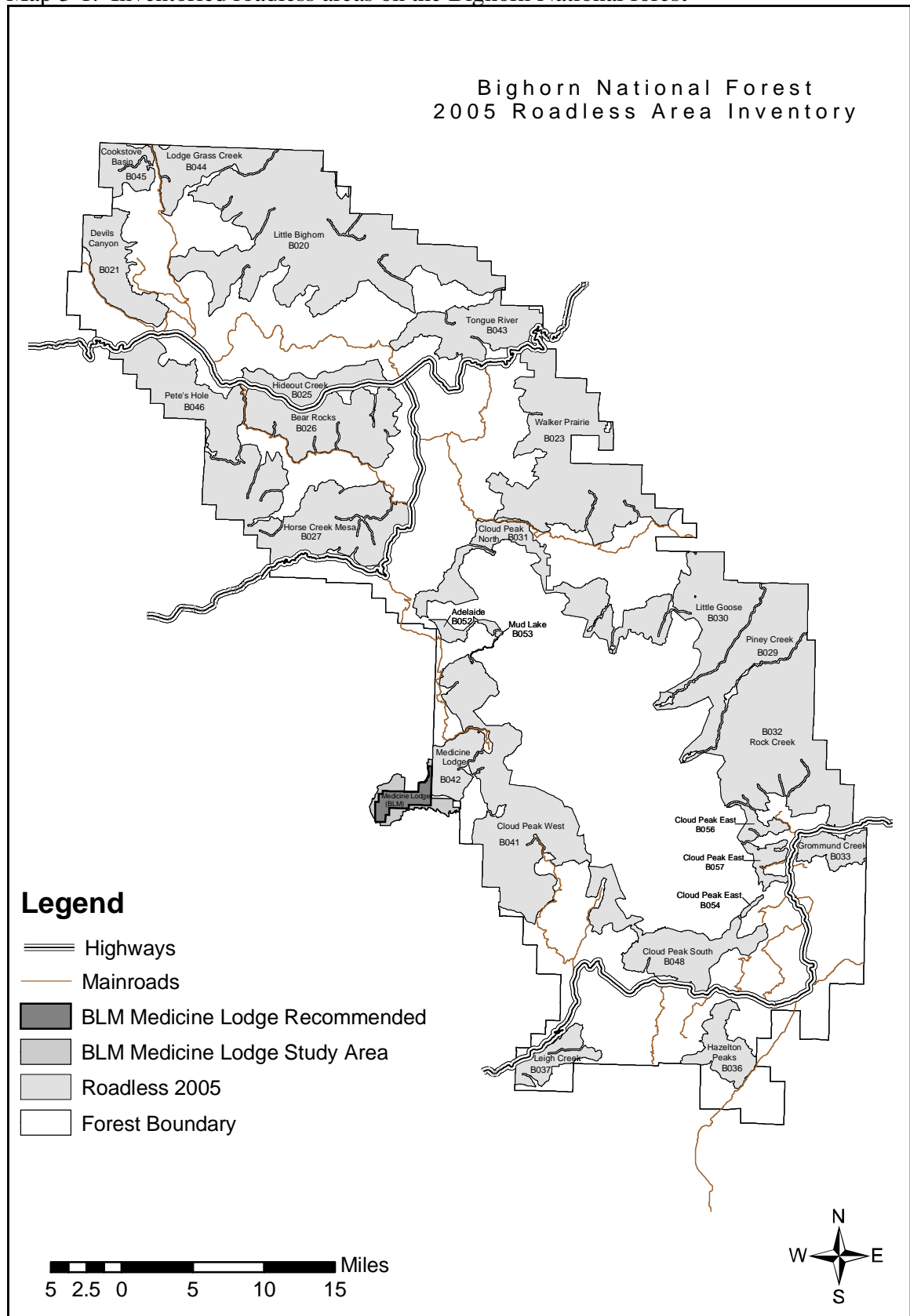
Under this definition the 2005 Roadless Area Inventory maps developed for the forest plan revision will become the current Roadless Area Inventory for the Bighorn National Forest.

AFFECTED ENVIRONMENT

On many National Forests, including the Bighorn, roadless area management has been a major concern for land management planning and program development. Roadless areas are valued for many resource benefits including their undeveloped fisheries and wildlife habitat, biological diversity, and nonmotorized recreation. The same areas are also valued for their development potential, particularly for wood products and motorized recreation. Controversy continues to accompany most proposals to harvest timber, build roads, or otherwise develop inventoried roadless areas.

During forest plan revision, the Forest Service is required to inventory, evaluate, and consider roadless areas for possible inclusion in the National Wilderness Preservation System (36 CFR 219.17)

Map 3-1. Inventoried roadless areas on the Bighorn National forest



Inventory of Roadless Areas for the Forest Plan Revision

Areas included in the 2005 forest plan revision inventory of roadless areas met the following criteria from the Wilderness Act and FSH 1909.12:

- ◆ Areas contain 5,000 acres or more.
- ◆ Areas contain less than 5,000 acres, but are contiguous to the existing wilderness or areas recommended for wilderness in other federal ownerships.
- ◆ Areas do not contain classified roads. Inventoried roadless areas may contain motorized and nonmotorized trails and user created roads. (Classified road are roads wholly or partially within or adjacent to National Forest System lands that are determined to be needed for long-term motor vehicle access, including State roads, county roads, privately owned roads, National Forest System roads, and other roads authorized by the Forest Service. [36 CFR 212.1]).

Inventoried roadless areas may contain improvements such as motorized trails, unauthorized and user-created roads, fences, outfitter camps, cow camps, and evidence of historic logging activities. Recent timber harvest areas, utility corridors, ski areas, and large reservoirs were excluded from the inventory. The following table and previous map show the twenty-five areas included in the revision inventory. Descriptions of the specific areas are in Appendix C of the FEIS.

Table 3-130. Inventoried roadless areas with area numbers and acreages.

	Area Number	Inventoried Roadless Area - Name	Acres
1.	B020	Little Bighorn	80,132
2.	B021	Devil Canyon	14,204
3.	B023	Walker Prairie	49,533
4.	B025	Hideout Creek	9,285
5.	B026	Bear Rocks	24,994
6.	B027	Horse Creek Mesa	41,682
7.	B029	Piney Creek	22,932
8.	B030	Little Goose	24,848
9.	B031	Cloud Peak Contiguous North	17,425
10.	B032	Rock Creek	47,648
11.	B033	Grommund Creek	6,192
12.	B036	Hazelton Peaks	8,975
13.	B037	Leigh Creek	6,700
14.	B041	Cloud Peak Contiguous West	45,245
15.	B042	Medicine Lodge	7,572
16.	B043	Tongue River	17,297
17.	B044	Lodge Grass	11,935
18.	B045	Cookstove Basin	7,274
19.	B046	Pete's Hole	20,302

	Area Number	Inventoried Roadless Area - Name	Acres
20.	B048	Cloud Peak Contiguous South	22,068
21.	B052	Adelaide	2,023
22.	B053	Mud Lake	112
23.	B054	Cloud Peak Contiguous East	383
24.	B056	Cloud Peak Contiguous East	2,668
25.	B057	Cloud Peak Contiguous East	3,274
	Total Acres		494,703

Source: GIS Inventory – 2005 Roadless Area Inventory

The 494,703 inventoried roadless acres are approximately 45% of the total Bighorn National Forest. The 1979 RARE II inventory included 629,770 acres or 62% of the forest. The more recent inventory area is smaller for a variety of reasons. A partial list includes development of new roads, new timber harvests, and exclusion of all classified roads.

Roadless Acres Determined to be Capable and Available

Each of the 25 inventoried roadless areas was studied to determine its potential for wilderness designation. All inventoried roadless areas were assessed for capability and availability. A need analysis was then completed. The steps are described below.

- ◆ **Capability** is the degree to which a potential wilderness contains the basic characteristics that qualify it for wilderness designation, without regard to its availability. Factors such as opportunity for solitude, natural character, physical challenge, primitive recreation opportunities, environmental features, and manageability were analyzed and evaluated for each area.
- ◆ **Availability** is conditioned by the value of and need for the wilderness resource compared to the value of and need for other resources. To be available for wilderness, the values of the wilderness resource should offset the value of resources that formal wilderness designation would forego. Lands that are considered better suited for development and management other than wilderness, or committed for purposes not in concert with the requirements of the Wilderness Act, may be determined as unavailable for wilderness
- ◆ **Need** analysis considers public involvement. It compares geographic distribution of wilderness areas with the demand for additional wilderness recreation opportunities on the forest. Need analysis also considers the opportunity to include examples of landforms and ecosystems not previously included in wilderness areas. The need analysis does not represent a decision to recommend, which is outside the inventory and analysis process.

Eight areas on the Bighorn National Forest were identified as capable of and available for wilderness recommendation (see table below). These areas contain a total 273,008 acres or approximately 25% of the total forest acres.

Table 3-131. Inventoried roadless areas capable of and available for wilderness recommendation.

	Inventoried Roadless Area - Name	Acres	Adjacent Wilderness or area recommended for wilderness designation
1	Little Bighorn	80,132	None
2	Devil Canyon	14,204	None
3	Walker Prairie	49,533	None
4	Horse Creek Mesa	41,682	None
5	Rock Creek	47,648	Cloud Peak
6	Medicine Lodge	7,572	Medicine Lodge*
7	Lodge Grass Creek	11,935	None
8	Pete's Hole	20,302	None
	Total Acres	273,008	

Source: GIS Inventory

An adjacent area – also named Medicine Lodge – was recommended for wilderness designation by the Bureau of Land Management (BLM). The BLM inventoried a 7,740 Medicine Lodge Wilderness Study Area (WY-010-240) and recommended 3,600 acres in September 1991. Combined, the forest's inventoried Medicine Lodge Roadless Area (B042) and the BLM recommendation would total 11,172 acres. Combined the forest's capable and available Medicine Lodge area (7,572acre) and the BLM recommended acres would total 9,172 acres.

Roadless Settings

Some people think of roadless areas as pristine areas where natural processes have exclusive sway, while other people think of roadless areas as simply areas without an open road. These very different definitions are at the root of continuing controversy over roadless area management. Continuing conflict has resulted in the stylized definition of roadless areas used for inventory in the Forest Service. This definition falls somewhere between the very idealized and the very inclusive definitions.

To understand where the highest quality roadless settings occur, we compared three inventories: roadless areas in 2005, existing scenic integrity in 2000, recreation opportunity spectrum (ROS) in 1998. Inventoried roadless areas were overlaid with areas with very high and high scenic integrity and the areas with primitive and semi-primitive nonmotorized recreation opportunities (this map is on file in the administrative record). The scenic integrity inventory focuses on visual characteristics ranging from undeveloped to developed land. The ROS inventory focuses on recreation experiences ranging from primitive to urban settings. By overlaying the least developed and more primitive areas with the roadless areas, core areas with the high quality roadless settings may be identified.

ENVIRONMENTAL CONSEQUENCES

General Effects

Areas Recommended for Wilderness

In Alternative C, five areas are assigned to MA 1.2 Recommended Wilderness. These areas include portions of the Little Bighorn, Rock Creek, Walkers Prairie, Devil Canyon and Medicine Lodge roadless areas. In Alternative D-FEIS, a portion of the Rock Creek roadless area is assigned to MA 1.2 Recommended Wilderness. A recommended wilderness management area allocation does not create a wilderness. Congress must pass legislation designating wilderness. A Management Area 1.2 allocation protects the values that make the area suitable for wilderness designation. The following table provides details on the acres and areas recommended for wilderness.

Table 3-132. Inventoried roadless areas and acres recommended for wilderness in alternatives

Inventoried Roadless Area - Name	Inventoried Roadless Area - Acres	Acres Assigned to the 1.2 Management Area	
		Alternative C	Alternative D-FEIS
Little Bighorn	80,132	46,470	
Devil Canyon	14,204	4,930	
Walker Prairie	49,533	44,763	
Rock Creek	47,648	20,327	33,857
Medicine Lodge	7,572	5,672	
Total	199,089	122,162	33,857

The areas recommended for wilderness were identified using indications of public support and each areas combination of special features. Special features included the following:

- ◆ Large areas or topography that provided opportunities for solitude and primitive recreation.
- ◆ Under-represented geology and landforms (particularly sedimentary geology and canyons).
- ◆ Boundaries contiguous with existing wilderness or areas recommended for wilderness.
- ◆ The presence of wildlife species, including Yellowstone cutthroat trout, water vole, sage grouse, marten or bighorn sheep, as well as records of wolverine sightings.
- ◆ Sensitive plants, rare taxa and their representative vegetation communities
- ◆ Under-represented covertypes in existing wilderness – grasses, sagebrush, aspen, cottonwood/willow, Douglas-fir, limber pine, ponderosa pine, and pinyon-juniper.

For details on the special features of each area refer to FEIS Appendix C, Roadless Area Management.

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Three areas suitable for wilderness designation – Horse Creek Mesa, Lodge Grass Creek and Pete’s Hole – were not recommended for designation in any alternative considered in detail. These areas generally did not possess special features that were substantially different from, or of greater quality than, those in the areas included in Alternative C.

Four inventoried roadless areas recommended for designation in Alternative C were not included in Alternative D-FEIS – Little Bighorn, Devil Canyon, Walker Prairie, and Medicine Lodge. There was both considerable public support for Alternative C and considerable public opposition to additional wilderness recommendations. These areas were assigned to other management area allocations based on natural features and public input. The following table shows how the inventoried roadless acres were allocated.

Table 3-133. Allocation of inventoried roadless areas classified capable and available but not recommended for wilderness.

Mgmt Rx	Rock Creek Alt D-FEIS	Little Bighorn Alt D-FEIS	Devil Canyon Alt D-FEIS	Walker Prairie Alt D-FEIS	Medicine Lodge Alt D-FEIS
1.2	33,711				
1.31		7,960			
1.32		8,322	4,561		3,452
1.33		4,271			
1.5		10,961			
2.2		4,845			
3.31	1,494				
3.4		1,758			
3.5	693	26,899		36,195	
4.2	2,207			1,654	
4.3				331	1,236
4.4					
5.11		7,279		8,052	
5.12		864	562		
5.13		1,331		1,697	
5.4		5,642	1,428		
5.41	9,543				
5.5				1,604	2,884
MW*			7,653		
Total Acres	47,648	80,132	14,204	49,533	7,572

* MW applies to the Medicine Wheel area covered by the Historic Preservation Plan (HPP). Management of the area will continue under allocations, standards and guidelines in the existing forest plan as modified by the HPP.

In the Little Bighorn area, allocations for wild and scenic river segments (MA 1.5 and MA 3.4) were carried forward from the 1985 Forest Plan. A portion of the Little Bighorn area was included in the Mann Creek Research Natural Area. (MA 2.2). A popular long-distance race, the Bighorn Mountain Wild and Scenic Trail Run, occurs annually in this area. The competitive event is inconsistent with wilderness designation. A lack of support from local elected officials and/or adjacent landowners was important in the decision not to include Walker Prairie, Medicine Lodge, and Devil Canyon in Alternative D-FEIS.

Alternatives A, B, D-DEIS, and E do not contain any areas recommended for wilderness. Alternatives were developed with a particular resource emphasis in response to public comments. For example, Alternative B emphasizes biological and habitat diversity, Alternative C emphasizes retaining undeveloped land and natural ecological processes, and Alternative D-DEIS emphasizes active vegetation management. Alternative D-FEIS is a synthesis based on DEIS comments. Chapter 2 of the FEIS describes the alternatives in greater detail.

Effects of Management Area Allocations on Wilderness Potential and Roadless

Characteristics: The following chart shows the distribution of the 497,703 roadless acres inventoried, for the forest plan revision, across the range of management areas in each alternative. All of the acres shown are included in the roadless inventory done for forest plan revision. Forest acres outside of inventoried roadless areas are not included in this table.

Table 3-134. Allocation of inventoried roadless acres to various management areas by alternative.

Mgmt Rx	Alt A	Alt B	Alt C	Alt D-DEIS	Alt D-FEIS	Alt E
1.2			121,985		33,710	
1.31		33,948		24,701	8,764	7,504
1.32	54,419	41,631	70,322	35,899	57,092	25,817
1.33	16,487	31,503	35,767	6,044	7,165	13,268
1.5	12,051	20,760	21,926	10,230	15,599	10,387
2.1		17,716	14,741			
2.2	1,050	20,600	20,597	20,599	6,004	1,050
3.1		7,652	7,652	7,652		7,652
3.24	136					
3.31	11,030	65,126	114,175	62,742	47,632	4,011
3.4	14,615	4441	3,515	1,754	4,536	1,331
3.5	118,718	139,678	19,082	77,472	79,166	
4.2	3,868	19,821	17,869	25,700	24,046	4,603
4.3		18,228	7,402	15,008	10,149	1,504
4.4		8,597	8,597	63	2,123	

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Mgmt Rx	Alt A	Alt B	Alt C	Alt D-DEIS	Alt D-FEIS	Alt E
5.11	50,727	12,268	9,566	74,318	37,588	124,381
5.12	119,229	21,745	2,129	98,064	71,065	36,501
5.13	64,900	4,725		8,450	8,015	60,754
5.21	2,986					
5.4					29,776	115,402
5.41	24,487	26,264	19,378	26,007	30,335	27,006
5.5					14,286	53,532
MW					7,652	
Total	474,703	474,703	474,703	474,703	474,703	474,703

Source: GIS (ARC/Info), roadless inventory and management area prescription layers.

The management area allocation can be grouped into two broad categories: allocations allowing activities which could compromise roadless characteristics and allocations which generally retain roadless characteristics. These groupings were developed from the desired condition statements, standards and guidelines, and overall management emphasis for each management area allocation. For those management area allocations allowing activities which could compromise roadless characteristics, an estimate of the extent of effects was needed. To estimate the acres actually affected by future management, the Interdisciplinary Team (ID Team) considered activities during the past 20 years and the anticipated future activities. Timber management and road development are expected to have the most effect on roadless conditions as defined in the inventory process. The allowable sale quantity (ASQ) was used as an indicator of those activities. Among the many variables which are difficult to estimate are the effects of budgets, litigation, and the state petitioning process under 36 CFR 294. Not all management activities are expected to decrease roadless conditions. Closing roads or converting them to motorized trails would increase the acres inventoried as roadless.

The following table shows the percent of inventoried roadless acres the ID Team estimated would be considered roadless under each management area prescription at the end of the planning period (i.e., 15 years or 2020). For example – 100% of acres inventoried as roadless and allocated to a Wild River management area are expected to be inventoried as roadless again at the end the planning period. In comparison – 80% of the acres currently inventoried as roadless and allocated to a Forest Vegetation Emphasis management area are expected to be inventoried as roadless again in 2020.

Table 3-135. Estimated percent of inventoried roadless area acres retained in a roadless condition by management area in the year 2020.

Management Area Number and Name		% of MA Retained in Roadless Condition
1.11	Pristine Wilderness	100
1.12	Semi-primitive Wilderness	100
1.2	Recommended Wilderness	100
1.31	Backcountry Recreation, Nonmotorized	100
1.32	Backcountry Recreation, Nonmotorized Summer Use with Limited Winter Motorized Use	100
1.33	Backcountry Recreation with Limited Summer and Winter Motorized Use	100
1.5	Wild River	100
2.1	Special Interest Areas – Cultural Resources	90
2.2	Research Natural Areas	100
3.1	Special Interest Areas – Cultural Resources	95
3.24	Riparian and Aquatic Ecosystem Management	100
3.31	Backcountry Recreation – motorized	90
3.4	Scenic River	95
3.5	Plant and Wildlife Habitat Management	90
4.2	Scenery	80
4.3	Dispersed Recreation	90
4.4	Recreation River	90
5.11	Forest Vegetation Emphasis	80
5.12	Rangeland Vegetation Emphasis	90
5.13	Forest Products	70
5.21	Increased Water Yield – Vegetative Management	70
5.4	Plant and Wildlife Habitat	85
5.41	Deer and Elk Winter Range	95
5.5	Dispersed Recreation and Forest Products	80
MW	Medicine Wheel	95

Management area allocations will not directly affect the character of inventoried roadless areas until a planned management activity (e.g., road construction, vegetative treatment) is scheduled. The type and amount of management activities in the future are uncertain, but most management area direction allows activities that are not consistent with roadless characteristics. Management Areas 1.11, 1.13, 1.2, 1.5, and 2.2 generally do not allow

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inconsistent activities. To comply with FSH 1909.15 20.6, management activities that substantially alter the undeveloped character of an inventoried roadless area of 5,000 acres or more would generally require preparation of an Environmental Impact Statement (EIS).

The following table summarizes the estimate of inventoried roadless area acres remaining in a roadless condition under each alternative at the end of 15 years. To develop this table the acres assigned to each management area were multiplied by the “percent of roadless acres retained in a roadless condition” from the table above. The sum of the products is shown as the “acres retaining roadless character” in the table below. The anticipated loss of roadless acres in the next planning period is similar to the rate of change experienced in the last planning period for all alternatives except C and E. The estimated distribution of the acres in individual, inventoried roadless areas at the end of the planning period is included in Appendix C of this document.

Table 3-136. Estimated distribution of current inventoried roadless area acres in 2020

	Alt A	Alt B	Alt C	Alt D-DEIS	Alt D-FEIS	Alt E
Acres Retaining Roadless Character	441,620 (89%)	451,257 (91%)	471,076 (95%)	445,041 (90%)	449,491 (91%)	416,626 (84%)
Acres Not Retaining Roadless Character	53,083 (11%)	43,446 (9%)	23,627 (5%)	49,662 (10%)	45,212 (9%)	78,077 (16%)
Total Acres	494,703	494,703	494,703	494,703	494,703	494,703

It may be possible to reduce the loss of roadless characteristics under some management prescriptions. The applicability and practicality of such design criteria depends on site-specific information and analysis. Some methods to reduce effects include road closure and obliteration, modified silvicultural prescriptions, emulating natural patterns and shapes in harvest unit design, and modified logging methods. A recent trend to convert low-standard, classified roads to motorized trails increases roadless acres under the current inventory rules.

Twenty-five roadless areas were inventoried and 8 of those areas were classified as capable and available for wilderness designation. The following table shows how the acres in those eight areas might be affected during the plan’s fifteen year life under each alternative.

Table 3-137. Estimated distribution of current inventoried roadless area acres classified as capable and available in 2020.

	Alt A	Alt B	Alt C	Alt D-DEIS	Alt D-FEIS	Alt E
Acres Retaining Roadless Character	242,977 (89%)	248,437 (91%)	259,358 (95%)	245,707 (90%)	248,437 (91%)	229,327 (84%)
Acres Not Retaining Roadless Character	30,031 (11%)	24,571 (9%)	13,650 (5%)	27,301 (10%)	24,571 (9%)	43,681 (16%)
Total Acres	273,008	273,008	273,008	273,008	273,008	273,008

Direct and Indirect Effects

Effects from Recreation Management: Areas that are recommended for wilderness will be managed similarly to lands currently designated as wilderness. Recommendation of an area for wilderness designation may lead to increased recreation use. An increase in use may trigger development or improvement of trailhead facilities and other visitor use management techniques. Opportunities for primitive and nonmotorized recreation will be found in inventoried roadless areas recommended for wilderness designation. These areas provide the best opportunities for solitude, the absence of motorized or mechanized vehicles, and the absence of human developments. Only Alternative C and D-FEIS provide areas managed like and recommended for wilderness.

Inventoried roadless areas in prescriptions that preserve roadless qualities are at risk from the recreation use of all terrain vehicles (ATVs). Unclassified user-created ATV routes encroach on some inventoried roadless areas. This long term effect of illegal motorized use can be the loss of some roadless values.

Inventoried roadless areas that are assigned to other management areas will be managed for the recreation opportunities appropriate to the assigned management areas. The existing settings are generally semi-primitive nonmotorized in character although motorized trails occur in some areas. Snowmobiles traveling over snow – on trails or cross-country – occur in some inventoried roadless areas. Alternatives rank C, B, D-FEIS, D-DEIS, A, and E, from most to least semi-primitive nonmotorized settings.

Effects from Timber Management: Inventoried roadless areas that are allocated to MA 1.2 (recommended wilderness) are not available for timber harvest. Inventoried roadless areas that are allocated to management areas other than recommended wilderness may be available for vegetation treatments, including timber harvest consistent with the standards and guidelines found in the forest plan.

Acres assigned to Management Areas 5.11, 5.12, 5.13, 5.4, 5.5, and MW (Medicine Wheel) include both forested and non-forested acres. Of the forested acres in these management areas, a portion is suitable for timber management. The acres of suited timber are included in the allowable sale quantity (ASQ) for the Bighorn. The following table shows how many acres from inventoried roadless areas are included in the forest's ASQ by

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alternative. While not all suited acres will be treated in the next planning period, the allocation represents the availability of these acres to be treated and they could all be harvested within the first rotation (see Revised Plan Chapter 1, silviculture guideline 6).

Table 3-138. Inventoried roadless area acres with suited timber assigned to management areas contributing to the ASQ.

Roadless Area Name	Acres of Suited Timber (M.A. 5.11, 5.12, 5.13, 5.4, 5.5, MW)					
	Alt A	Alt B	Alt C	Alt D-DEIS	Alt D-FEIS	Alt E
Little Bighorn	9,088	1,325	836	3,778	3,329	16,048
Devil Canyon		1,524	1,025	1,872	1,822	2,209
Walker Prairie	19,736	446		6,905	6,753	19,871
Hideout Creek	1,085	1,134	1,134	1,134	1,246	1,564
Bear Rocks	4,708			2,154	1,930	6,011
Horse Creek Mesa	3,695			3,243	3,138	3,833
Piney Creek	6,664					8,145
Little Goose	14,541			138	4,245	14,859
Cloud Peak Contiguous North	2,355	347		4,826	1,983	6,361
Rock Creek	13,709			86		21,425
Grommund Creek	618	85	13	636	772	1,000
Hazelton Peaks	3,534	433	477	1,671	1,955	3,937
Leigh Creek	195	106		106	113	217
Cloud Peak Contiguous West	7,536	1,399	213	7,161	5,952	9,124
Medicine Lodge	2,068	1,217	217	1,972	1,521	3,169
Tongue River	578	1	1	2,470	2,057	3,298
Lodge Grass Creek	2,009	101		2,137	2,151	2,151
Cookstove Basin	830	1,665		1,665	1,661	1,661
Pete's Hole	3,579			3,787	3,031	4,150
Cloud Peak Contiguous South	2,367	1,316	1,336	1,983	1,516	3,320
Adelaide	2			2		495
Mud Lake						
Cloud Peak Contiguous East Fragments (B054)	335	368	368	368	368	368
Cloud Peak Contiguous East Fragments (B056)	420			360	1,585	1,313
Cloud Peak Contiguous East Fragments (B057)	2,403	478	478	2,156	2,239	2,435
Total Acres	102,056	11,944	6,098	50,609	49,367	136,964

Effects from Travel Management: Inventoried roadless areas may provide a variety of travel opportunities depending on the management area assigned. Areas recommended for

wilderness (MA 1.2) will permit foot and horse travel and will prohibit motorized travel. Areas in MA 1.2 have very little motorized use under current travel management rules.

Management prescriptions that do not allow additional road construction would affect inventoried roadless areas the least, thus alternatives that contain more of those management areas – C, and B – would have the least effect on inventoried roadless areas. Alternatives E, A, D-DEIS, and D-FEIS have more inventoried roadless acres in prescriptions allowing road construction.

Effects from Special Area Allocations: Both RNA and wild river designation will protect wilderness values; although they are managed for other purposes. In Alternative B, C, D-DEIS and E, Research Natural Area (RNA) proposals (MA 2.2) overlap portions of the Little Bighorn, and Rock Creek areas capable and available for wilderness designation. Wild river recommendations (MA 1.5) overlap a portion of the Devil Canyon, Little Bighorn, and Rock Creek areas.

In Alternative D-FEIS a potential Research Natural Area overlaps a portion of the Little Bighorn Roadless Area capable and available for wilderness designation. A wild river recommendation also overlaps a portion of the Little Bighorn Roadless Area. The overlaps reduce the area recommended for wilderness (MA 1.2) in Alternative C. In Alternative D-FEIS, the Rock Creek area recommended for wilderness includes the area of the potential Pheasant Creek RNA.

Effects from Oil, Gas and Minerals Management: Inventoried roadless areas in prescriptions which are administratively unavailable for oil, gas and mineral development will be largely unaffected by development. All other inventoried roadless areas are potentially affected by development of minerals under the mining law, although there is little history of mineral development on the Forest. Based on the history of drilling near the Forest, it is unlikely that any oil and gas test wells will be drilled on the Forest in the foreseeable future.

Cumulative Effects

The cumulative effects table at the beginning of this chapter includes the list of past, present and reasonably foreseeable future activities that were considered for the roadless resource. Effects were considered for the life of the Revise Plan. The area of consideration is the Bighorn National Forest and the surrounding region – northern Wyoming, southeast Montana, and the Black Hills.

The Bureau of Land Management (BLM) has recommended 3,600 acres in the Medicine Lodge area (BLM inventory #WY-010-240) for wilderness designation. This area includes the Medicine Lodge Canyon and parts of Medicine Lodge and Captain Jack Creek under BLM administration. The Forest's Medicine Lodge roadless inventory area (inventory #B042) connects to the BLM area and includes higher elevation reaches of Medicine Lodge Creek, Lower Medicine Lodge Lake, and a part of Allen Draw. The past recommendation for wilderness designation of an adjacent area under BLM administration has the effect of strengthening the wilderness potential of the Forest's Medicine Lodge

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roadless area. This effect extends from the past into the reasonably foreseeable future and applies to the upper and lower Medicine Lodge Creek watersheds.

Inventoried roadless area characteristics are changed by development such as roads, timber management, recreation facilities, reservoirs, etc. The development of the Bighorn National Forest for human benefit is a long-term continuing trend. Although the total acres developed in the past planning period is relatively small, the decrease in acres with roadless characteristics is a long-term continuing trend. The development of roads and management of timber stands has affected the most acres in the past and this trend may continue. While some development is reversible, the benefits of development - for individuals, groups, or society as a whole - make changes from a developed state to an undeveloped state unusual. The effect of development extends from the past into the future and applies to the general forest area (i.e., outside wilderness).

The alternatives rank C, D-FEIS, B, D-DEIS, A, and E from most to least area retaining a roadless undeveloped character over the next 15 years. Over the long-term, the effect of development is least under Alternative C and D-FEIS, where areas are recommended for wilderness designation. In terms of wilderness recommendations, the alternatives rank C, D-FEIS, B, D-DEIS, A, and E from most to least area recommended.

The marketing of all-terrain vehicles (ATVs) and other off-road vehicle (ORV) experiences has produced accelerating growth in this use of the Bighorn National Forest. Since an ATV rider can travel across larger areas in a shorter time than most other recreation users, the demand for access to more terrain is likely to increase. Advocates for ATV users are likely to focus their requests for increased access on inventoried roadless areas. The effects of increasing ATV use and demand for access extend from the past into the future and apply to the general forest area. These effects would decrease in alternatives where more area is allocated for wilderness recommendation and nonmotorized backcountry travel.

Unclassified motorized routes, both roads and trails, have been created and/or extended by use in some places on the Forest. These unclassified routes or segments are not legal for motorized travel. The lack of adequate, well-maintained signing contributes to this problem. Use of unclassified routes has occurred in both roaded and roadless parts of the Forest. To the extent that this use continues to occur in the future, it diminishes roadless values and roadless areas. As both local and national populations continue to age the demand for easier access, primarily vehicle access, to destinations in inventoried roadless areas is expected to increase. The effect of user-created routes is forest-wide and extends from the past into the present. The effect of user-created routes is expected to decline in the future under Alternative C as a result of new prohibitions on motorized use in areas recommended for wilderness designation.

To summarize, inventoried roadless areas can be affected by development activities and motorized recreation. In general terms, the alternatives rank E, A, D-DEIS, B, D-FEIS, and C from most to least impact on roadless resources into the future.

Scenery Resources

Introduction

Scenery management is concerned with providing scenic integrity, through time, to meet the public desire for attractive natural landscapes and to support recreation and tourism uses. The Scenery Management System (SMS) replaces the Visual Management System (VMS) used in the 1985 Bighorn National Forest Land and Resource Management Plan. The Scenery Management System (SMS) is used to inventory and analyze scenery, to assist in establishing resource goals and objectives, to monitor the scenic resource, and to ensure high-quality scenery for future generations. The new system applies to all national forests and grasslands administered by the Forest Service and to all Forest Service management activities.

Legal and Administrative Framework

The Multiple-Use Sustained-Yield Act of 1960 (16 U.S.C. 528) authorizes and directs the Secretary of Agriculture “to develop and administer the renewable surface resources of the National Forests” for “harmonious and coordinated management of the various resources . . . with consideration being given to the relative values of the various resources, and not necessarily the combination of uses that will give the greatest dollar return or the greatest unit output.”

The Forest and Rangeland Renewable Resources Planning Act of 1974, as amended by the National Forest Management Act of 1976 (16 U.S.C. 1601) directs the Secretary of Agriculture to prepare land management plans which provide for outdoor recreation and to develop and keep current a comprehensive inventory of all National Forest System, as well as state and private, lands and resources. Section 6 of this act requires an assessment of potential aesthetic impacts during the interdisciplinary review of proposed timber sale areas that would include clear-cutting and other cuts designed to regenerate an even-aged stand of timber. It also specifies treatment of cut blocks and protection of aesthetic resources, and directs that multiple use and sustainable yield guidelines be used with private lands involved with Government programs.

The National Forest Management Act of 1976 (16 U.S.C. 1600) requires that the removal of trees, portions of trees, or forest products “be compatible with multiple use resource management objectives in the affected area.”

- ◆ Title 36 of the Code of Federal Regulations, Part 219, Subpart A, National Forest System Land and Resource Management Planning (36 CFR part 219, subpart A), includes requirements for consideration, treatment, and protection of intangible resources such as scenery and aesthetics.

- ◆ Title 36 of the Code of Federal Regulations, Part 219, Subpart A, 219.21 (f) National Forest System Land and Resource Management Planning (36 CFR part 219.21(f), “The visual resource shall be inventoried and evaluated as an integrated part of evaluating alternatives in the forest planning process, addressing both the landscape’s visual attractiveness and the public’s visual expectation. Management prescriptions for definitive land areas of the forest shall include visual quality objectives.”
- ◆ Title 36 of the Code of Federal Regulations, Part 223, Sale and Disposal of National Forest System Timber (36 CFR part 223), includes requirements for protection of environmental quality and for minimizing adverse effects on, or providing protection for and enhancing, other National Forest System resources.

The National Environmental Policy Act of 1969 (42 U.S.C. 4321) directs the Federal Government to “(2) assure for all Americans ... healthful, productive, and aesthetically and culturally pleasing surroundings; (3) attain the widest range of beneficial uses of the environment without degradation, [or] risk to health ..., (4) preserve important historic, cultural, and natural aspects” of our environment. It further directs agencies to “insure the integrated use of the natural and social sciences and the environmental design arts in planning and in decision making which may have an impact on man’s environment.” This act directs agencies to develop methods and procedures “which will insure that [scenery and other] unquantified environmental amenities and values may be given appropriate consideration in decision making along with economic and technical considerations.”

The Wilderness Act of 1964 (16 U.S.C. 1131) directs the United States to administer wilderness areas to provide for the “preservation of their wilderness character,” to retain their “primeval character and influence,” and to protect and manage the natural conditions of wilderness areas so that they “generally appear to have been affected primarily by the forces of nature, with the imprint of man’s work substantially unnoticeable.” Scenic use is identified as one of the six public purposes of wilderness areas.

- ◆ **Title 36 of the Code of Federal Regulations, Part 293, Wilderness – Primitive Areas (36 CFR part 293)** includes requirements for scenic use, preservation and protection of wilderness character, and promotion and perpetuation of specific values including solitude and inspiration.
- ◆ **Title 36 of the Code of Federal Regulations, Part 292, National Recreation Areas (36 CFR part 292)** includes requirements for preservation, conservation, and protection of natural, scenic, and pastoral values, and other values contributing to public enjoyment of these areas.

The National Trails System Act of 1968 (16 U.S.C. 1241) authorizes the Secretary of Agriculture to administer and manage national scenic trails “for the conservation and enjoyment of the nationally significant scenic, historic, natural, or cultural qualities of the areas through which such trails may pass.”

The Intermodal Surface Transportation Efficiency Act of 1991 (23 U.S.C. 101) directs the establishment of a National Scenic Byways Program with designation criteria to include consideration of scenic beauty. It further recommends that designated travel ways have operation and maintenance standards which include “strategies for . . . protecting and enhancing the landscape and view corridors surrounding such a highway.”

The Wild and Scenic Rivers Act of 1968 (16 U.S.C. 1271) directs the United States, in its administration of components of the National Wild And Scenic Rivers System, to give primary emphasis to protecting “its aesthetic, [and] scenic . . . features.”

- ♦ **Title 36 of the Code of Federal Regulations, Part 297, Wild and Scenic Rivers (36 CFR part 297)**, includes requirements for the protection of scenic and natural values from the effects of any water resources project.

The Surface Mining Control and Reclamation Act of 1977 (30 U.S.C. 1201) authorizes the Secretary of Agriculture to permit surface coal mining operations on National Forest System lands if there are no significant recreational or other values which may be incompatible.

- ♦ **Title 36 of the Code of Federal Regulations, Part 228, Subpart A, Locatable Minerals (36 CFR part 228, subpart A)** includes requirements for harmonizing mineral operations with scenic values (sec. 228.8), and protecting scenic values when approving access to those operations (sec. 228.12).

The North American Wetlands Conservation Act of 1989 (16 U.S.C. 4401, 4401-4413; 16 U.S.C. 669b) recognizes the aesthetic values of fish, shellfish, and other wildlife; it further recognizes that wetland ecosystems provide aquatic areas which are important for recreational and aesthetic purposes. It directs the head of each Federal agency, to the extent consistent with the agency’s mission and statutory authorities, to cooperate to restore, protect, and enhance the wetland ecosystems and other habitats for migratory birds, fish, and wildlife.

Title 36 of the Code of Federal Regulations, Part 254, Landownership Adjustments (36 CFR part 254), include requirements for protecting aesthetic values on lands involved in these transactions.

Title 36 of the Code of Federal Regulations, Part 290, Cave Resources Management (36 CFR part 290), includes requirements for protecting and maintaining the scenic values of significant caves.

FSM, Chapter 2380, Landscape Management provides direction for Forest Service landscape management including aesthetics and scenery

Resource Protection Measures

Scenery resource protection measures are included in forest-wide and management area standards and guidelines. Scenery resource methods and techniques are described in the following USDA handbooks:

- ◆ National Forest Landscape Management, Vol. 1. Agriculture Handbook 434: 1973.
 - ✧ National Forest Landscape Management, Vol. 2, Chapter 1: The Visual Management System. Agriculture Handbook 462: 1974.
 - ✧ Utilities, Volume 2 - Chapter 2. Agriculture Handbook 478: 1975.
 - ✧ Range, Volume 2 - Chapter 3. Agriculture Handbook 484: 1977.
 - ✧ Roads, Volume 2 - Chapter 4. Agriculture Handbook 483: 1977.
 - ✧ Timber, Volume 2 - Chapter 5. Agriculture Handbook 559: 1980.
 - ✧ Fire, Volume 2 - Chapter 6. Agriculture Handbook 608: 1985.
 - ✧ Ski Areas, Volume 2 - Chapter 7. Agriculture Handbook 617: 1984.
 - ✧ Recreation, Volume 2 - Chapter 8. Agriculture Handbook 666: 1987.
- ◆ Landscape Aesthetics, A Handbook for Scenery Management. Agriculture Handbook 710: 1995

AFFECTED ENVIRONMENT

The Bighorn National Forest covers about 39% of the isolated rolling plateau that makes up the Big Horn Mountain range. The Forest features rugged canyons and valleys on its flanks. A distinctive pattern of large, grassy parks interwoven with large areas of coniferous forests create expansive views. The Forest is topped by granite peaks with steep slopes and striking glacial formations.

The Big Horns are a visible presence in the lives of local people. “The mountain” is a part of the identity of surrounding communities. The attractive scenery of the Bighorn National Forest is a basic resource supporting local tourism and recreation. Tourism and recreation is an important segment of the economy for some communities around the forest. Some businesses operating on the forest – resorts, campground concessions, and outfitter-guides - depend on the scenic beauty of the forest to help attract customers.

Scenery management is concerned with providing scenic integrity, through time, to meet the public desire for attractive natural landscapes and to support recreation and tourism.

Constituent Information

Studies at the national and local scale consistently show that the public places a high value on the forest's scenic beauty. Managing resources with consideration for the forest's scenery is strongly supported.

National Survey on Recreation and the Environment (NSRE)

- ◆ Surveyed 60,000 households in the United States.
- ◆ 86.8 % of respondents said "Managing forest to leave them natural looking" was important or very important.

Social Assessment of the 4-County Area

- ◆ Survey of 1,230 households in Big Horn, Washakie, Johnson, and Sheridan counties.
- ◆ Respondents from every County ranked "consider forest appearance in making decisions" 2nd out of 13 desired future conditions.

Scenic Byway Corridor Management Plan

- ◆ 60 forest users (both tourists and locals) were interviewed.
- ◆ 60% of forest users thought scenic quality should strongly influence land management decisions along the Byways in order to maintain a high quality, scenic setting.
- ◆ 30% of those interviewed thought scenic quality should be given equal consideration with other resources in influencing land management decisions.

The Scenic Integrity Scale

The scenic integrity scale is used to describe both existing and desired conditions. The scenic integrity scale describes a range of scenic quality conditions. The first five categories are not inherently good or bad. This scale is a continuum of scenic condition ranging from a landscape where changes are natural occurrences, to a landscape where management activities and uses overwhelm the original landscape character. This scale is used to evaluate existing condition and to describe future objectives. In general, landscapes with very high, high, and moderate scenic integrity have a natural appearance; landscapes with low, very low, and unacceptably low scenic integrity are dominated to varying degrees by development and use.

Very high

The valued landscape character "is" intact with only minute if any deviation. The existing landscape character and sense of place is expressed at the highest possible level.

High	The valued landscape character “appears” intact. Deviations may be present but must repeat the form, line, color, texture and pattern common to the landscape character so completely and at such scale that they are not evident.
Moderate	The valued landscape character “appears slightly altered.” Noticeable deviations must remain visually subordinate to the landscape character being viewed.
Low	The valued landscape character “appears moderately altered.” Deviations begin to dominate the valued landscape character being viewed but they borrow valued attributes such as size, shape, edge effect, and pattern of natural openings, vegetative type changes, or architectural styles outside the landscape being viewed. They should not only appear as valued character outside the landscape being viewed but compatible or complimentary to the character within.
Very Low	The valued landscape character “appears heavily altered.” Deviations may strongly dominate the valued landscape character. They may borrow from valued attributes such as size, shape, edge effect, and pattern of natural openings, vegetative type changes, or architectural styles within or outside the landscape being viewed. However deviations must be shaped and blended with the natural terrain (land forms) so that elements such as unnatural edges roads, landings, and structures do not dominate the composition.
Unacceptably Low	The valued landscape character being viewed “appears extremely altered.” Deviations are extremely dominant and borrow little if any form, line, color, texture, pattern, or scale from the landscape character. Landscapes at this level of integrity need rehabilitation. This level should only be used to inventory existing integrity. It must not be used as a management objective.

The Forest’s Existing Scenic Integrity

The existing scenic integrity (ESI) inventory maps the current state of the forest landscapes at a broad scale. In rating scenic integrity, the degree to which an area appears natural is considered. Similarly, the degree of contrast between a natural appearance and the appearance introduced by management activities and uses is considered. An undeveloped area with a few trails and few signs of human use (i.e., campsites) has very high scenic integrity. An area of the forest with timber harvest units, very reduced crown cover and new seedling trees, has low or very low scenic integrity. The rating considers how the

harvest units relate to the shape, size, edge effect, and pattern of natural openings and other elements in the surrounding landscape. Areas of the forest are classified into one of five categories, from very high scenic integrity to very low scenic integrity. No areas were classified in a sixth category, unacceptably low scenic integrity.

Table 3-139. Existing Scenic Integrity (CY 2000) as a percent of the total area.

	Very High ESI	High ESI	Moderate ESI	Low ESI	Very Low ESI
Areas Outside of Wilderness	3%	32%	34%	19%	12%
Wilderness	72%	28%			
Forestwide	15%	31%	29%	15%	10%

As the table shows, the majority of the forest area (60%) has a high or moderate level of scenic integrity. Seventy-five percent of the forest is in the upper half of the scenic integrity scale with ratings as very high, high, or moderate scenic integrity. Forest users are accustomed to this level of scenic integrity.

A 1997 study of the existing scenic integrity of the Clear Creek/Crazy Woman Creek geographic area compared scenic integrity levels in 1976 and 1996. The study was part of a landscape analysis prepared to support both future project work and future forest plan revision. It revealed a 28% loss in acres of high scenic integrity as development (e.g., timber harvest, travel routes, fences, and reservoirs) increased. The study also showed an improvement in areas with large clear-cuts edged by narrow leave strips. As these clear-cuts were restocked with young trees they moved from the unacceptably low into the very low scenic integrity category. Acres of moderate, low, and very low scenic integrity increased in the 20-year study period. The study indicated a trend toward the middle range of the scenic integrity scale with more acres in moderate and low scenic integrity categories. It also suggests a priority be given to preserving or managing areas to achieve very high and high scenic integrity in the future. Areas with high and very high scenic integrity are an important component of the Forest that meet the public desire for attractive natural landscapes for recreation and tourism.

The Concern Level Inventory

Concern levels are an estimate of the degree of public importance placed on scenery viewed from roads, trails, and use areas (e.g., campgrounds, overlooks, cabins). There are three concern levels:

- ◆ **Concern Level 1** – People have the highest interest in scenery from these travel ways and use areas. The number of visitors using Concern Level 1 travel ways and uses areas can be high, moderate, or low. The Bighorn Scenic Byway (U.S. 14), Tongue River Trail (FST 002), Sheep Mountain Road (FSR 445), and the Paint Rock Lakes Road (FSR 17) are examples of Concern Level 1 travel routes.

- ◆ **Concern Level 2** – People have a moderate interest in scenery from these primary and secondary travel ways and use areas. The number of visitors using Concern Level 2 travel ways and uses areas can be high, moderate, or low. Pole Creek Road (FSR 31), and Battle Park Road (FSR 24) are examples of Concern Level 2 travel ways
- ◆ **Concern Level 3** – People have a low interest in scenery from these primary and secondary travel ways and use areas. The number of visitors using Concern Level 3 travel ways and uses areas can be moderate or low. Some local roads, service roads and all remaining areas not seen from travel routes and use areas are Concern Level 3.

The concern level inventory helps describe the places where scenery is viewed. These viewpoints are used in a visibility analysis of the forest.

Table 3-140. Concern levels for roads and trails.

Concern Levels	Road and Trail Miles
Level 1	670
Level 2	492
Level 3	235
No concern level established	1,476

Scenic Classes

Scenic classes indicate the relative importance of scenery in different areas of the forest. Scenic classes are used during forest planning to compare the importance of scenery with the importance of other resources in various areas. Mapping is based on a combination of scenic attractiveness and visibility. The scenic class maps on the Bighorn National Forest assign Class 1 areas a high value as scenery. Class 2 areas are assigned a moderate value, while classes 3 and 4 through 7 have low value.

Table 3-141. Scenic classes on the Bighorn National Forest.

Scenic Class	Acres	Percent
1	811,809	72.6%
2	280,783	25.1%
3	20,723	1.9%
4 through 7	4,186	0.4%
Totals	1,117,501	100.0%

The Scenic Byways

There are three scenic byways crossing the Bighorn National Forest: the Bighorn Scenic Byway (U.S. Highway 14), the Medicine Wheel Passage Scenic Byway (U.S. Highway 14A) and the Cloud Peak Skyway (U.S. Highway 16). Each road provides a unique and different view of the Bighorn because they vary in viewshed, vegetation, geologic features, and historic uses. They provide opportunities for 120 miles of scenic travel on the Forest. These roads provide forest access for the majority of tourists and local visitors. A 2003

National Visitor Use Monitoring study reported an annual use figure of 2,032,000 travelers viewing national forest scenery from the Forest's scenic byways.

ENVIRONMENTAL CONSEQUENCES

General Effects

Changes in scenery may be the result of natural events and human activities; however scenic integrity evaluations consider only the results of human activities and use. Project planning, design and layout techniques may be used to minimize changes in scenic integrity. How noticeable changes are is affected by the observer's viewing location, distance from the change, the season, landform and vegetation screening, weather conditions and the duration of the view.

Management activities and uses such as timber harvest, road building, mining, grazing, utilities, trail construction, ski area development and developed and dispersed recreation affect scenery. Activities designed to blend in with the surrounding landscape may have a positive effect on scenic integrity; poorly designed activities that contrast sharply with the surrounding landscape usually result in an adverse effect on scenic integrity. The planning, design and layout of projects is critical to achievement of scenic integrity objectives.

Each alternative developed for the forest plan revision includes varied management prescriptions and each management prescription is assigned a proposed scenic integrity objective(s) based on the desired condition of the management area. Scenic integrity objectives assigned to management area prescriptions influence the amount, degree, intensity, and distribution of management activities needed to achieve the desired condition. Distribution includes both distribution in space and distribution through time. Very low scenic integrity is not identified as an objective in either the current forest plan or the proposed revision. Historically, there has been strong criticism of management to the level of very low scenic integrity. In areas with very low scenic integrity – approximately 10% of the forest - a rehabilitation scenic integrity objective may be applied.

The table below indicates that areas with high scenic integrity are likely to decline while acres with moderate and low scenic integrity are likely to increase under each of the alternatives. The magnitude of this effect depends on the acres altered and time-span considered. Forest-wide during the next planning period, change in scenic integrity would be significantly less than the amount indicated by the prescribed scenic integrity objectives. However, scenery guidelines would allow for change from the existing condition to the percent shown by alternative. In general, Alternatives rank C, B, D-DEIS, D-FEIS, A, and E in terms of increasing impacts on scenic integrity.

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Table 3-142. Percent of forest area assigned to each scenic integrity objective by alternative (with a comparison to the existing condition).

SIO	Alternatives						Existing Condition
	A	B	C	D-DEIS	D-FEIS	E	
Very High	12%	12%	23%	12%	15%	12%	15%
High	17%	21%	21%	17%	17%	14%	31%
Moderate	45%	55%	50%	49%	42%	37%	29%
Low	26%	12%	6%	22%	26%	37%	15%
Very Low	0%	0%	0%	0%	0%	0%	10%

A management area prescription helps define the purpose and need for future projects in that area. The 4.2 - Scenery prescription provides for management activities that provide for the public enjoyment of scenery over time. The scenery prescription is applied to areas of concentrated recreation use (ex. campgrounds, visitor centers) and along scenic byways. The following table shows acres allocated to the scenery prescription in the alternatives. Approximately 56% of the 4.2 area is forested. Of the forested acres approximately 45% is tentatively suited for wood fiber production. MA 4.2 is not part of the suited timber base, however, it is an active management prescription, and some vegetation management is expected to develop and maintain scenic quality.

Table 3-143. Acres in MA 4.2 (scenery management) by alternative.

	Alt. D-DEIS	Alt. B	Alt. C	Alt. D-FEIS	Alt. A	Alt. E
Acres in MA 4.2	102,083	95,418	93,294	83,591	19,147	6,007
MA 4.2 as a % of Total Forest Acres	9%	7%	8%	8%	2%	<1%

The scenic byways provide millions the opportunity to enjoy scenic beauty. As shown by the following table, alternatives vary in how many miles of the byway corridors would be managed for scenery values and uses. Alternative D-DEIS allocated the largest percent of the byway corridors to the scenery prescription, followed by D-FEIS, B, C, and A. Alternatives E allocates less than one percent of the total byway miles to the prescription.

Table 3-144. Miles of scenic byway included in the scenery and recreation management areas.

	Alt. D-DEIS	Alt. D-FEIS	Alt. B	Alt. C	Alt. A	Alt. E.
Miles of Byway in MA 4.2	113.8	113.8	103.8	100.2	46.4	7.6
% of Total Byway Miles	95%	95%	86%	83%	39%	<1%

Direct and Indirect Effects

Effects from Insects and Disease and Fire and Fuels Management: In all alternatives, natural disturbance factors have the potential to alter the appearance of the Forest. While these changes are consistent with the landscape character of the Bighorn National Forest, people object to the appearance of widespread areas of damaged or diseased trees. It is difficult to compare the potential effects of natural insects, disease, or wildfire to the more predictable effects of management activities and development. Opportunities to minimize natural disturbances through active management will be evaluated for scenery effects when projects are developed. Opportunities may be identified for rehabilitation work to reduce the visual effects of insects, disease and wildfire. Insects, disease, and wildfire are natural disturbance factors with a high potential to change scenic beauty but no direct effect on scenic integrity. Indirect effects to scenic integrity might result from the use of dozers in fire suppression or development of roads for timber salvage.

Prescribed fires that are used to reduce fuels, improve forest, range and habitat conditions also affect the scenery. The significance of the effect depends on the vegetation type(s), the number of acres treated and the duration of the effect. Prescribed fires in range land usually have short term visual effects. Prescribed fire with crown fires in a timber stand usually have a more apparent and lasting impact. Other types of fuel treatments (e.g., thinning and burn piles) affect scenery as well. Based on the prescribed burning projected annually for forested acres, impacts on scenery would be highest under Alternative D-FEISat 1,150 acres, B at 1,100 acres, and D-DEIS at 1,050 acres. Alternatives A, C, and E would treat 500 acres or less annually.

Effects from Facilities: Forest Service facilities, including permitted facilities are required to comply with the built environment image guide and the applicable scenic integrity objective. Recreation facilities should be consistent with the applicable recreation opportunity spectrum (ROS) class. Facilities that are properly designed, located and built to fit in with the surrounding landscape may enhance visitor experiences. Many existing facilities (e.g. campgrounds, trailheads, work centers, resorts) blend well with the surrounding landscape. Facilities that clash with the landscape setting as a result of poor design, construction, or maintenance have an adverse effect on scenery resources. The effect on scenic integrity of managing existing facilities and developing new facilities is expected to be similar under all alternatives.

Effects from Utility Corridors: Utility corridors have the potential to alter the landscape in all alternatives. Some negative effects occur with new corridors or when existing corridors are upgraded. The forest-wide guideline calling for installation of new electric service lines below ground would minimize impacts on scenery for that class of utility. The scenic integrity objective for the management area(s) crossed would apply to utility lines. At present there are no proposals for major transmission lines or pipelines across the forest. The effects on scenery vary by the type and location of the corridor and would be evaluated at the project level.

Effects from Mineral and Energy Development: Mineral and energy development may affect scenery on the forest. Scenic integrity would be reduced if the landscape is modified by energy development. Location of structures (e.g., roads, pipes, pumpjacks, tanks, and fences) would affect scenery. Mineral development is likely to be for common minerals, primarily gravel. Restoration of disturbed sites is covered in standards and guidelines. Alternatives C has fewer acres available under standard lease terms for energy development than other alternatives.

Effects from Livestock Grazing and Big Game Use: Intense forage utilization and new range improvements may affect scenic integrity. The most likely effects would be from seasonal trampling and trailing and the development of new fence and water improvements. Generally improvements are small and localized and have minor individual effects on scenic integrity. The effects of intense forage utilization would be most evident in riparian areas. The potential effects of livestock grazing are similar in all alternatives.

Effects from Recreation Management: Recreation use and recreation management may affect scenery. Unmanaged recreation use often results in resource damage and unauthorized, non-system, motorized travel routes. The impacts to soil, water and vegetation are detrimental to scenery.

Dispersed recreation sites have few facilities to protect soil, water and vegetation. These sites are often viewed in the foreground zone of roads. Where resource damage (e.g, loss of vegetation, soil compaction, scarred trees) occurs there is a negative effect on scenery. Restoration and/or relocation could improve resource conditions and enhance scenery.

Clearing for ski trails, lifts, roads, utilities and buildings associated with ski areas affects scenic integrity. Negative effects are usually most noticeable in densely forested areas. As with other types of tree removal, effects may be reduced by use of design techniques such as partial clearing, thinning, irregular edges and shapes, variable widths for linear features and remnant islands. Effects would be similar under all alternatives

Effects from Timber Management: Timber management activities can be designed to minimize effects on scenic integrity, although design criteria may conflict, in varying degrees, with timber management objectives. Timber harvest can be used to maintain or enhance scenic integrity over time if that objective is identified in project planning. Negative effects on scenic integrity are usually noticed when harvest units dominate the landscape. Management areas emphasizing forest products from suited timber lands (5.11, 5.12, 5.13, 5.21, 5.4, and 5.5) have the potential for reduced scenic integrity as a result of timber management. As shown below, the potential is highest in Alternative E, followed by A, D-DEIS, D-FEIS, B, and C.

Table 3-145. Percent of Bighorn National Forest in management areas emphasizing production of wood products.

Management Area # and Name	Alt. A	Alt. B	Alt. C	Alt. D-DEIS	Alt. D FEIS	Alt. E
5.11 Forest Vegetation Emphasis	8%	8%	8%	15%	7%	17%
5.12 Rangeland Vegetation Emphasis	24%	7%	2%	16%	14%	5%
5.13 Forest Products	19%	8%		9%	10%	18%
5.21 Water Yield Increase	< 1%					
5.4 Plant and Wildlife / Forest Products					5%	12%
5.5 Dispersed Recreation / Forest Products					4%	18%
Totals	51%	23%	10%	40%	36%	70%

Timber harvest and associated road building covers more acres and introduces more noticeable landscape changes than other ground-disturbing activities on the Forest. Generally even-aged management has a greater visual impact than uneven-aged management.

Even-aged management includes clear-cut and shelterwood harvest. The visual effects of new clearcut units, with scarified soil and slash on the ground, last longest. The effect is somewhat diminished with “green-up” when bare soil or burning is no longer visible. Establishment of a new forest with crown closure takes 20-30 years and establishment of a new forest overhead takes 60 or more years in the average lodgepole pine stand. All alternatives provide for the use of even-aged management of lodgepole pine. Shelterwood harvest removes trees in two or three entries and the final harvest removes most large trees from the harvest unit. Extending the harvest cycle in a shelterwood, may shorten the recovery period, if young trees established after the first entry are protected during the second entry. Extending the harvest cycle in a shelterwood may also lengthen the recovery period, if a new stand is not established until after the second entry. Even aged harvest can lower scenic integrity for many decades.

The use of a scenic integrity objective of moderate in the foreground zone of concern level one and two roads, trails and use areas reduces the effect of harvest from the most important viewpoints. This design criteria is included as a guideline in Management Areas 5.11, 5.12, 5.4, and 5.5. The guidelines for scenery in the 5.13 management areas do not provide for a moderate SIO in the foreground of most concern level one and two roads and trails. By using a low SIO instead of a moderate SIO, the production of wood fiber will be less constrained. The foreground zone of six roads and three trails listed in a scenery guideline for Management Area 5.13 would have an SIO of moderate.

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Table 3-146. Projected acres of harvest in the first 15 years by alternative.

	Alt. A	Alt. B	Alt. C	Alt. D-DEIS	Alt. D-FEIS	Alt. E
Acres of Clear-cut Harvest	15,135	7,065	3,195	10,575	10,365	16,995
Acres of Shelterwood Harvest	1,290	2,310	720	3,525	3,690	2,805
Acres of Even-Aged Selection Harvest	17,985	6,600	3,555	11,685	11,460	21,750

Source: Stanley model data

Table 3-147. Projected acres of harvest in the first 50 years by alternative.

	Alt. A	Alt. B	Alt. C	Alt. D-DEIS	Alt. D-FEIS	Alt. E
Acres of Clear-cut Harvest	50,450	23,550	10,650	35,250	34,550	56,650
Acres of Shelterwood Harvest	4,300	7,700	2,400	11,750	12,300	9,350
Acres of Even-Aged Selection Harvest	59,950	22,000	11,850	38,950	38,200	72,500

Source: Stanley model data

The effect of uneven-aged management on scenic integrity is less pronounced. Uneven-aged management involves repeated entries on a 20-30 year cutting cycle, but some large overstory trees are retained over time. The visual impact may be noticeable but is usually not as striking as the final entry of a shelterwood harvest or a clear-cut.

The accumulation of woody debris as a result of repeated harvest and thinning operations affects both scenic integrity and recreation use. On the Bighorn National Forest, a brief warm season and limited moisture result in a slow rate of natural decomposition. As a result twigs and branches remain from harvests completed twenty or thirty years ago.

Effects from Roads and Trails: Poorly designed and located roads or trails with bare cut and fill slopes detract from the surrounding landscape when viewed from other travel ways and use areas. Roads and trails built to fit in the landscape can support enjoyment of scenic beauty. A proliferation of regulatory and information signs, particularly on higher standard roads, can lower scenic integrity.

Development of new roads and trails has a mixed impact on scenery. Travel routes provide the platform for viewing the natural beauty of the forest. When roads and motorized trails occur at high densities the scenic integrity of the area declines. (This decrease occurs even when roads are closed to motorized use.) The development of a road system in the Little Goose/Rock Creek area would decrease scenic integrity while making the scenery more accessible. Alternatives listed in order, from those most to those least likely to involve new or upgraded roads, are E, A, D-DEIS, D-FEIS, B, and C.

Areas with few roads generally have higher scenic integrity and are more intact than areas with higher road densities. Decommissioning roads determined to be unneeded will not

affect scenic integrity. However, decommissioning a road and restoring it to natural contour and vegetation, can improve the scenic integrity of the landscape. Alternative E is most likely to add roads and have an effect on scenic integrity followed by A. Estimated levels of decommissioning do not vary by alternative.

Effects from Wildlife and Fisheries Management: Higher levels of species richness and intact habitats are consistent with higher scenic integrity. Habitat improvements would reduce scenic integrity if large scale changes in forest age class distribution are undertaken in 5.4 Plant and Wildlife - Forest Products management areas. The 5.4 MA provides for converting large forest areas to an early seral stage for habitat and wood fiber production. Smaller scale projects are expected to have minor effects on scenic integrity.

Cumulative Effects

The cumulative effects table at the beginning of Chapter 3 includes the list of past, present and reasonably foreseeable future activities that were considered for the scenery resource. Effects were evaluated for the Bighorn National Forest and the four surrounding counties for the next planning period (10-15 years into the future).

Any activities implemented on Forest lands (roads and trails, timber harvest, recreation development, prescribed fire, etc.) can affect scenery when viewed from nearby lands. The appraised value of property is often influenced by the proximity to the forest and the of natural appearing landscapes (i.e. high scenic integrity) of the forest.

A cumulative effect of the subdivision of rural acreage and the development of residences is to raise the level of concern for scenic integrity. This effect is likely to increase over time as subdivision and development increases. The effect is similar for all alternatives, although alternatives that emphasize more active management may be more difficult to implement.

In conclusion, in consideration of the the existing scenic integrity levels and the the proposed scenic integrity objectives, the cumulative impact of the alteratives on the scenery resource ranked from most to least is E, A, D-DEIS, D-FEIS, B, and C. The largest impacts are expected to result from vegetation treatments, motorized access. Vegetation treatments might include harvests, thinning, and prescribed fire. Highways, roads and motorized trail impacts might include development, improvement, maintenance and partial obliteration.

Travel Management

Introduction

Travel is associated with virtually every activity that takes place on the Bighorn National Forest. Travel is necessary for outdoor recreation, fighting wildfires, managing livestock and wildlife, removing marketable natural resources such as logs and minerals, gathering fuelwood, access to private and special use permit areas and inholdings, maintaining electronic sites and utility corridors, and managing and monitoring the Forest in general.

Travel management is a tool used to facilitate the movement of people and products. It provides opportunities for the activities listed above and protects resources, mitigates impacts, and minimizes conflicts. Decisions that affect travel opportunities in a given area are emotional issues for many Forest users. Each time a travel management decision is implemented, some users will benefit, and others will not. For example, when an area or road is restricted from motorized travel to protect wildlife, there is a secondary effect on people. The closure prohibits motorized travel and protects the wildlife, but it also restricts access for persons with disabilities, limits firewood gathering, and reduces opportunities for some forms of recreation. Conversely, it would likely give hikers, mountain bikers, horseback riders, and those viewing wildlife or seeking solitude a more peaceful, undisturbed experience.

Modes of vehicular travel on the Forest include large commercial trucks, automobiles, pickups, four-wheel drive vehicles, snowmobiles, all-terrain and off-highway vehicles, motorcycles, mountain bikes, and wheelchairs. Other travel modes include cross-country skiing, snowshoeing, horseback riding, and hiking. These various forms of travel may occur on paved highways, gravel and dirt roads, unimproved roads, four-wheel drive roads, and trails designated for motorized and/or nonmotorized use. Off-road and off-trail motorized vehicle travel is allowed only for snowmobiles unless an area is expressly designated open by Forest order. Of particular interest is the emergence of mountain bikes and increased off-highway vehicle (OHV) and snowmobile use since the 1985 Plan.

As use of the Forest increases, travel management will be increasingly important as a tool for mitigating impacts on the various resources and for coordinating uses. The Forest needs to work closely with all user groups to maintain travel and recreation opportunities and identify routes where these activities can continue. Public information and education regarding travel management and the need for restrictions must be emphasized. A balance between motorized and nonmotorized recreation opportunities needs to be achieved and is likely to require compromises by each user group to mitigate conflicting demands.

Legal and Administrative Framework

The Forest and Rangeland Renewable Resources Planning Act of 1974, Section 10.

36 CFR 212. Administration of the National Forest System Roads (NFSR) provides the principle regulations for administration of National Forest System roads.

36 CFR 219.11 provides resource management requirements that cannot be met without putting a viable transportation system in place.

Forest Service Manual (FSM) 7700. Transportation Systems.

Forest Service Handbooks (FSH) 7709. Transportation and Related Activities

Resource Protection Measures

The location, design, operation, and maintenance of roads and trails are specified in the forestwide standards and guidelines, Watershed Conservation Practices Handbook, and Forest Service manual direction. This direction assures that intended uses will be accommodated over time, and necessary mitigation measures will be used.

Maintenance accomplishments on Forest roads are directly dependent upon funding levels, and vary from year to year.

AFFECTED ENVIRONMENT

Roads

There are currently 1,544 miles of classified National Forest System roads (NFSRs) on the Forest transportation inventory as shown in the following table. These roads are broken down by objective maintenance level in the table below. Objective maintenance levels represent the target, or objective, to which the road is to be maintained. Sometimes these targets are not achieved, and the actual maintenance occurring on the ground is different than the objective. For this reason, there is another category for maintenance levels: the operational maintenance level. These mileages include all roads on the Bighorn National Forest except for the 3 U.S. highways. Many roads included in the road totals on the Forest fall under jurisdictions or ownerships and maintenance responsibility other than Forest Service.

Table 3-148. Miles of classified road on the Forest by objective maintenance level.

Objective Maintenance Level	Miles
1 – closed (basic custodial care)	538
2 – Suitable for use by high clearance vehicles only	745
3 – Suitable for passenger vehicles	162
4 – passenger vehicles with moderate degree of user comfort	98
5 – passenger vehicles with high degree of user comfort	1
TOTAL ROAD MILES	1,544

Source: *INFRA travel routes database*

All roads on the Bighorn National Forest are also broken down by functional class, which includes the categories arterial, collector, or local. Arterial and collector roads are used to provide primary access to large portions of the National Forest. Arterials normally serve as connections between towns, major county roads, or state highways and are main thoroughfares through the Forest. Collectors link large areas of the Forest to arterials or other main highways. Local roads are usually single-purpose transportation facilities.

The 1985 Forest Plan contains the following general road maintenance direction:

- ◆ Arterial and open collector roads – maintained to a minimum of maintenance level 3.
- ◆ Open local roads – maintained to minimum of a maintenance level 2 standard.
- ◆ Closed roads – maintained to a maintenance level 1 standard.

The following table shows miles of classified road by functional class. It is important to note that this table consists of all roads on the Forest, not just roads under Forest Service jurisdiction.

Table 3-149. Miles of classified road by functional class.

Functional Class	Miles	Percent
Arterial	116	8
Collector	124	8
Local (includes open and closed)	1,304	84
Total	1,544	

Source: *INFRA travel routes database*

In general, most arterial and collector roads are aggregate-surfaced roads, and most local roads are native-surfaced or surfaced without any form of aggregate. The major exception to this generalization is that nearly all campgrounds, picnic grounds, and trailheads are aggregate-surfaced but are still classified as local roads. Currently, there are approximately 185 miles of road on the Forest that have aggregate surfacing. Aggregate surfacing on these roads may consist of pit-run or crushed gravel. Pit run gravel is material that can be removed from a pit and be placed directly on the road without running it through a crusher. The expected life of a gravel surface can be 10 to 25 years when adequate maintenance is performed, depending on the amount and type of traffic.

Assuming an average life of 20 years, the Forest should be re-surfacing a minimum of 9 miles per year. Currently, the Forest does not meet that average because of a lack of funding.

Public Forest Service Roads

An important aspect of National Forest System roads is that they are not public roads. Although they generally are open and available for public use, they are authorized only for the administration, protection, and utilization of National Forest System lands.

The Forest Service can designate certain National Forest System roads as public roads. By definition, a public Forest Service road (PFSR) is a National Forest System road that is designated "open to public travel" in accordance with 23USCs101(a). The roads must serve a compelling public need. By definition, the roads would remain open and meet Federal Highway Safety Act requirements. Exceptions would be for scheduled seasonal closures or emergency closure needs. To date, and per agreement with the Federal Highway Administration, maintenance level 3-5 roads have been subject to the Highway Safety Act requirements but without the public road designation.

The Forest Service has identified potential roads for public Forest Service road classification, along with the associated construction work required to meet the public road standards. The Forest Service Region 2 Regional Office has prioritized the projects to be accomplished as money becomes available. Roads may be designated as Public Forest Service Roads when they meet the appropriate standards. Further analysis through travel management and NEPA is also required, as is the Roads Analysis Process (RAP).

Unclassified Travelways

In addition to roads and trails classified for motorized use, there are roads that have developed through off-road travel, old "temporary" roads that were never decommissioned or decommissioned ineffectively, abandoned roads that were never rehabilitated, and user-created roads. These routes provide foot, horse, and mountain bike opportunities for those desiring a more challenging experience. These routes are not maintained. They are inventoried and evaluated for possible classification, decommissioning, or conversion to other uses during site-specific analyses. There are approximately 274 miles of these unclassified roads that have been inventoried over the past several years. Additional unclassified roads can be expected to be identified and evaluated in future site-specific analyses. As future user-created routes are identified, they will be decommissioned or added to the transportation system and given a maintenance level, following a site-specific, project level analysis that shall include the roads analysis process, and a documented decision.

Future Trends

The last 10 to 15 years has seen a shift in the volume and mix of travel modes on the Forest. All forms of recreation travel have increased in volume, some more dramatically than others. Modes of vehicle travel include large commercial trucks, automobiles, high-clearance vehicles, four-wheel drive vehicles, all-terrain vehicles, motorcycles, snowmobiles, mountain bikes, and wheelchairs. Other modes of travel include cross-country skiing, snowshoeing, horseback riding, pack animal driving, hiking, and boating. Variations in these increasing volumes can be attributed to a number of reasons: technological advances, economic conditions, changing demands for recreational experiences, population increases, and other social influences.

Along with the multitude of diverse use has come an increasing demand for segregating the uses. The common conflicts are between motorized and nonmotorized users, both in winter and summer. Management area designations have begun to address these concerns, and future travel management plans will address travel on specific roads, trails, and areas.

ENVIRONMENTAL CONSEQUENCES

General Effects

Most of the Forest's roads and trails for the current level of use are in place. Maintaining or decommissioning existing roads and trails are emphasized in all the alternatives. Projections for new construction are much lower than was predicted in the previous planning period. Commercial use of the transportation system declined in the 1990s. On the other hand, recreation traffic has increased. This shift in traffic composition and user types is a driving force for development of new travel management philosophies and strategies.

Under all alternatives, areas currently open to summer off-road motorized travel (C areas) will be changed to "A" areas where all summer motorized travel is restricted to designated routes.

Decisions about closing roads or motorized routes will not be made during Forest Plan revision. Subsequent travel management planning will be conducted at the project level and will incorporate the NEPA process, including public involvement. These decisions may result in new road construction, or road reconstruction, road decommissioning, or road closures.

Methods of decommissioning include, but are not limited to, signing and physical closures such as earth berms, boulders, scattering downed vegetation, scarifying, seeding, recontouring, and removal of structures such as culverts and restoration of original drainage patterns. The goal is to return the roadway to a more natural state where the

roadway is hydrologically self-maintaining and to permanently remove it from the transportation system. Other roads may be identified for closure for a period of more than one year (level 1 maintenance roads). These roads are identified as roads not needed for current use but possibly needed for future management access. The intent is to preserve the road investment while eliminating vehicle use. These roads are retained as part of the transportation system. Methods of closure include gates and signing, earth berms, boulders, scattering downed vegetation, scarifying, and seeding. The intent for closing roads and bringing them to a maintenance level 1 standard is to significantly reduce the maintenance costs on the road, while still retaining the ability to open the road when there is a need. The need for re-opening level 1 roads is generally associated with timber harvest activities (personal use and commercial use), fire protection, and vegetative management.

New standards and guidelines have been developed to mitigate impacts on natural resources resulting from increased traffic on forest roads and trails, while trying to protect the main infrastructure investment. Nationally, the trend is to redirect maintenance funding to decommissioning unneeded roads and improve the maintenance condition of those remaining. A slightly smaller, more efficient transportation system is the expected outcome.

Roads Analysis

The Bighorn National Forest Roads Analysis Process (RAP) was completed in the spring of 2003. This analysis addressed only those roads maintained for passenger vehicle use on the Forest. It is not a decision document, but it provides valuable information for managing the road system on the Forest. It offers many opportunities and guidelines for road managers and decision makers. It is also a tool to help identify a potential minimum road system. Further analysis is needed at the project level to determine management of specific roads. The RAP can be found in the project record.

Maintenance and Reconstruction

Annual road maintenance will vary slightly across alternatives according to the total miles of system roads to be maintained. Past annual maintenance accomplishments are approximately 99% of roads maintained for passenger vehicle use (maintenance level 3, 4, 5) and 90% of roads maintained for high clearance vehicles (maintenance level 2), and 95% of closed roads (maintenance level 1). With no alternative actually proposing to decommission any system roads, annual operating costs will remain fairly constant across all alternatives. There will, however be a change in the amount of maintenance required in the alternatives that propose to reduce the amount of open roads, and increase the amount of closed, or level 1 roads. Alternatives A and E will close more roads than the others, thus potentially reducing the annual maintenance costs for the entire road system in these alternatives. Both of these alternatives, however, may require more miles of new road construction for logging purposes, thus increasing annual maintenance costs of the transportation system.

To meet standards for traffic safety and environmental protection, many existing roads will require reconstruction and maintenance. Reconstruction and maintenance of these roads

will remain constant throughout all alternatives. The objective of performing this work is to return the road to its originally designed operating standard. This work is generally referred to as deferred maintenance, as the level of work required is beyond that of routine, or annual, maintenance. An existing backlog of deferred maintenance is common across the National Forest System, including the Bighorn National Forest. There have been some major strides made in recent years to reduce some of the deferred maintenance associated with the transportation system using specifically allocated funding. This funding, however, has since been eliminated, and the Forest must use normal, allocated funds to remedy its deferred maintenance. Assuming current funding levels, lack of adequate funding for this work is expected to continue for some time and be similar across alternatives.

Road maintenance priorities established in the Bighorn Roads Analysis are as follows: health and safety, resource protection, and forest mission. With the total amount of system roads remaining relatively the same throughout all alternatives, opportunities to correcting deficiencies according to the above mentioned priorities will remain constant throughout all alternatives. Alternatives A and E, however, will have more miles of closed road than the others, thus reducing maintenance costs. This will lead to more maintenance dollars reaching deficiencies within these prioritized maintenance categories. Each of these alternatives do have the potential for more lengthy road construction to enter into the Piney Creek/Rock Creek area for logging, depending on the methods used in the site-specific NEPA process.

Unauthorized use of closed roads by motorized vehicles contributes to increased maintenance costs by requiring additional work to keep the roads closed, and protect from resource damage. Development and maintenance of a motorized trail system could help reduce resource damage on closed roads. However, an increase in funding would be necessary for developing and maintaining such a trail system.

Resource Protection

In all alternatives, protection of soil, aquatic, and riparian systems will be given more attention in future road operations. As standards, guidelines, and design criteria are implemented; stream crossings will either be rebuilt or removed. Bridges and arches will be preferred over round culverts. As the need for repair or replacement of existing structures arises, design will provide for added streambed and bank stability as well as for fish migration. Reconstruction of roads will include moving the travelways away from streams where feasible and reducing the size of the connected disturbed area. These opportunities will be addressed in site-specific analyses.

Access Needs

Under all alternatives, there would be coordination and collaboration with other federal, state, and county officials in the management of transportation facilities to and through the Forest to ensure that access is maintained, standards are consistent, safety issues are addressed, and efficiency is considered at all times.

Reasonable access to private inholdings has to be considered in travel management. In addition, existing and future rights-of-way and easements would continue to ensure that public access to National Forest System lands is maintained. As lands adjoining the Forest have shown a change in use patterns over time, previous access by the public across these private lands is also changing. Without public access, the portion of the roads on the Forest can lose their value and could be recommended for closure. Where public access is not available, roads on the Forest will be closed or a special use permit will be required for motorized use. This may restrict motorized access to portions of the Forest from some private lands.

Direct and Indirect Effects

Effects from Management Area Prescriptions: Effects on the Forest transportation system from management area prescriptions will be only slightly evident. Reductions in the road system will mostly result from project-level decisions to close or decommission unneeded roads and will be similar across all alternatives. Maintenance, improvement, and reconstruction of most Forest roads will continue and remain at levels similar to the present.

Depending on the allocation of acres to management areas with emphasis on unroaded characteristics, such as wilderness, proposed wilderness, and backcountry nonmotorized recreation, the amount of open roads and unclassified roads may vary, slightly, by alternative. Alternative C has a notable portion of the Forest allotted to these management area prescriptions. Management area direction for prescriptions 1.2, 1.31, and 1.32 (recommended wilderness, backcountry recreation nonmotorized, and backcountry recreation nonmotorized summer, respectively) do not call for any existing system roads to be decommissioned. They do suggest, however, that existing system roads within these management areas shall be closed, and that existing unclassified roads should be decommissioned. While closing roads will result in a decrease in overall maintenance costs, decommissioning roads (system or non-system) will require funding beyond normal operating costs. Traditional costs for road decommissioning have been in the neighborhood of \$3,000/mile but can vary greatly depending on the amount of work required. The Forest has historically decommissioned approximately 4 miles of road per year with its allocated budget and will continue on that pace, unless additional funding becomes available. Non-system roads within Management Areas 1.2, 1.31, and 1.32 that are deemed not necessary, based on a documented NEPA decision, and backed by a roads analysis, will be the priorities for decommissioning. Roads that are deemed necessary for these management areas that are unclassified will then receive a maintenance level and a road number. The following table illustrates the amount (approximate) of unclassified road within Management Areas 1.2, 1.31, and 1.32.

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Table 3-150. Miles of unclassified road in Management Areas 1.2, 1.31, and 1.32 by alternative.

Management Area	Alternative					
	A	B	C	D-DEIS	D-FEIS	E
1.2	0	0	8.5	0	0	0
1.31	0	1.8	0	0	0	0
1.32	4.2	7.8	7.8	3.2	2.5	3.2

Management Area 5.4, Plant and Wildlife Habitat, has two guidelines that may suggest closing or decommissioning some roads based on a site specific, separate analysis. There are currently 203.4 miles of existing, open road that lie within this management area, in alternative E, and 47.8 miles of open, system road in Alternative D-FEIS. Roads and motorized trails located in this analysis area must meet a density requirement of 1.0 miles of road or motorized trail per square mile, measured in each management area. Currently, all density requirements for this guideline are being met for all alternatives, except in Alternative E. The density of open roads and motorized trails in this area measures 1.03 mi./mi². As a result, this management area in alternative E will require the closure or decommissioning of enough road or motorized trail to get the density in this area to equal the minimum guideline requirement of 1.0 mi./mi². The mileage amount required to close or decommission to accomplish this would be approximately 0.67 miles of open road or motorized trail. The specifics on deciding which roads or trails to close or decommission in this area shall be addressed in a separate, site-specific travel management plan. The area where this guideline is in excess is in the Piney Creek area, in Alternative E only.

In addition, open roads and motorized trails need to meet a requirement of no more than 0.5 stream crossings per square mile in each 5.4 management area. This guideline could potentially drive an effort to reduce the number of stream crossings within these management areas. To accomplish this, roads or motorized trails would either need to be relocated so there were fewer stream crossings, or they would need to be closed or decommissioned to eliminate the road or trail all together. If needed, this procedure would be done using a site-specific travel management plan. This guideline is currently being met under all alternatives, except Alternative D-FEIS. Two of the 5.4 management areas exceed the crossing density guidelines under this alternative. They are located near Babione Creek and Doyle Creek, with respective crossing densities of 0.92 and 0.62 stream crossings per square mile of management area.

The following table shows existing mileage of open, system roads that lie within all management areas, by alternative.

Table 3-151. Miles of open system roads on the Bighorn National Forest by alternative.

Management Area	Alternative					
	A	B	C	D-DEIS	D-FEIS	E
1.11	0.0	0.0	0.0	0.0	0.0	0.0
1.13	0.0	0.0	0.0	0.0	0.0	0.0
1.2	0.0	0.0	7.4	0.0	0.0	0.0
1.31	0.0	0.1	0.2	0.1	0.0	4.0
1.32	16.5	0.6	0.1	1.4	2.2	9.1
1.33	4.6	3.7	0.0	0.7	0.0	1.7
1.5	3.7	3.2	3.9	0.0	0.2	0.2
2.1	0.9	11.5	11.5	0.0	0.0	0.0
2.2	0.0	0.0	0.0	0.0	0.0	0.0
3.1	0.0	27.6	27.6	27.6	0.0	27.6
MW	0.0	0.0	0.0	0.0	27.6	0.0
3.24	0.3	0.0	0.0	0.0	0.0	0.0
3.31	47.4	145.7	282.7	81.7	56.7	31.4
3.4	7.1	5.9	4.9	3.5	6.7	1.4
3.5	105.2	109	133.4	36.1	32.5	0.0
4.2	39.3	161.3	162.6	156.1	115.1	6.9
4.3	0.0	72.1	122	42.1	75.6	22.7
4.4	0.0	4.4	4.4	0.2	3.5	0.0
5.11	59.5	162	183.5	209.7	120.3	152.6
5.12	414.4	117.6	44.6	220.3	201.4	0.0
5.13	265	163.6	0.0	178.4	169.8	262.0
5.21	2.6	0.0	0.0	0.0	0.0	0.0
5.4	0.0	0.0	0.0	0.0	47.8	203.4
5.41	7.0	13.3	13.3	19.0	20.1	5.7
5.5	0.0	0.0	0.0	0.0	100.8	259.6
8.1	0.4	0.0	0.0	0.0	0.0	0.0
8.22	3.7	3.4	3.4	3.4	0.9	4.6

Effects from Timber Management: Most of the arterial and collector road system is in place to access timber; however new roads would be necessary to get to specific units for the most economical harvest. These roads will primarily be low standard, local roads and usually closed to public motorized use following harvest activities. Temporary roads used for access would be decommissioned when activities are completed. Alternatives A, E, and D-DEIS and D-FEIS would have higher levels of construction and reconstruction than

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Alternatives B and C. However, Alternatives A and E do propose to harvest timber from the Rock Creek / Piney Creek area. Access into this area would require construction of approximately 12 miles of arterial road. This road may remain open following sale activities, and may be constructed as a maintenance level 3 road (gravel surfaced). The majority of new roads constructed for timber harvest will be constructed to a level 2 standard, and most will be closed or decommissioned following harvest activities. The permanency and level of construction of each road for timber harvest shall be decided in site specific, project design processes. The following table shows the approximate miles of new road construction by alternative:

Table 3-152. Predicted increase in miles of road by alternative (average miles constructed annually, based on 50 year average).

Alternative	E	A	D-DEIS	B	D-FEIS	C
Road Construction (Miles/Yr)	2.1	1.7	1.2	0.8	0.6	0.4

A more significant impact to the road system is the amount of road maintenance accomplished. Timber and other commodity users contribute to road maintenance commensurate with their use. While timber hauling is active, the purchaser performs maintenance on those roads and Forest maintenance funds can be used on other roads. However, increased traffic from timber haul can create user conflicts and increase public safety concerns. These risks can be minimized through proper signing, road management, and contract administration. It should be noted that although maintenance is done by timber operators, it is proportional to their use, and its long-term effectiveness is greatly reduced because operators only maintain what they use based on how much they use it. It is not a means for obtaining total road maintenance. The amount of maintenance performed by timber operators will vary, slightly, by alternative. The alternatives having the most allocations of Management Area 5.13 will likely have the most road maintenance by timber operators. These alternatives are A, E, D-DEIS, and D-FEIS, in descending order.

Timber haul during winter can have both positive and negative effects. Snowmobile trails often follow existing roads; when timber hauling is active, use of the trail can be disrupted. Often, the solution is to temporarily relocate the trail while logging is active. One benefit to winter travelers is that roads and trailheads may be plowed open by the timber operator, allowing greater access for recreation traffic. It is likely that Alternatives A, E, and D-DEIS and D-FEIS will explore the possibilities for winter hauling practices more so than the other alternatives.

Effects on trails from timber harvest will be minimal. During project planning, trail locations are identified and mitigation measures applied when appropriate. Beneficial effects can be derived through removal of potentially hazardous trees adjacent to trails, improving access to trailheads, and maintaining vistas. Again, alternatives that will be more likely to affect trails will be A, E, and D-DEIS and D-FEIS in descending order.

Effects from Oil, Gas, and Minerals Management: Oil, gas and mineral exploration and development requires roads to be available for drilling, construction, maintenance, and production. The Bureau of Land Management petroleum geologist estimated there would be no oil and gas activity on the forest in the reasonably foreseeable future. For other minerals, the amount of new roads would likely be small, and some might be temporary. No roads have been built for any mineral purposes for at least the last six years. The difference in effects between alternatives is expected to be negligible to none.

Effects from Recreation Management: Increasingly, National Forest System lands are likely to be destinations of choice for people seeking high-quality outdoor recreation experiences. As recreation use increases, travel management may need to respond with more opportunities, a more efficient transportation system, and more mitigation techniques for addressing impacts. Increases in recreation use without adjustments in the transportation system could lead to lower visitor satisfaction and more conflict between users, especially when program budgets do not address this increase. These impacts will be addressed during a separate site-specific analysis that will encompass the majority of travel management issues and will include a signed decision. This will be common for all alternatives.

New road construction for recreation purposes will be insignificant for all alternatives. Recreation traffic has a large impact on road and trail conditions due to the high traffic volumes. Road and trail damage occurs when traffic peaks and wet weather conditions saturate the road surface and subgrade. Travel during these conditions can damage the road requiring more frequent maintenance or increased travel restrictions. This condition is fairly consistent for all alternatives.

The varied types of experiences recreation users expected adds complexity to travel management. On some roads, road standards will need to be upgraded to accommodate increased traffic volume and provide for user comfort and safety while protecting resources. This will be common to all alternatives. Increasing demand for semi-primitive and primitive uses such as hiking and cross-country skiing indicate a need for a more extensive trail system. These opportunities are most prevalent in Alternatives B, C, D-DEIS, and D-FEIS. Motorized users seeking challenging driving experiences could lead to the development of a motorized trail system. Converting unneeded roads into trails could provide for some of these uses. All alternatives shall address these concerns, however alternatives that will greater opportunities are B, C, D-DEIS, and D-FEIS.

Effects from Aquatic and Soil Management: It is estimated that 4 miles of road will be decommissioned annually under all alternatives. This will help mitigate erosion and promote fish passage. However, sediment movement and erosion will continue until project scale analysis identifies problem areas for aquatic and soil resources. Identification of these problem areas is just the first step in protecting these resources. Once areas are identified where roads can be relocated, reconstructed, or decommissioned, and work has begun, there will be an initial increase in erosion. This trend will be a very short one, and will prove beneficial to the resources, in the long run. Alternatives with the most road

construction (E, A, D-DEIS and D-FEIS, B, and C in descending order) have the potential for more erosion and thus greater impacts on aquatic resources.

Effects from Wildlife Management: Fewer miles of road open to motorized travel in certain areas can lead to improved habitat for wildlife. Seasonal closures can be utilized to protect wildlife during critical periods, while allowing for motorized use during less critical times. Road closure efforts focused in critical habitat areas will provide for greater increase in habitat.

Protection measures and enhancements for elk security will have some effect on the road system. An increase in elk security areas means fewer roads in the area, thus fewer opportunities for motorists and ATVs, in addition to timber harvest and fuel wood reductions.

Protection measures for lynx and lynx habitat, should they occur, will have minimal impacts on road activities. Most of the measures identified are already required under current Forest Service policies and procedures.

Cumulative Effects

The cumulative effects table at the beginning of this chapter includes the list of past, present, and reasonably foreseeable future activities that were considered with regard to cumulative effects to travel management. Specifically, the table shows projected road construction miles in the reasonably foreseeable future within the cumulative effects area. For road construction, the cumulative effects boundary includes the Bighorn Basin and the Powder River Basin. The time period considered is the expected 15-year lifespan of the Revised Plan.

Within this area, it is estimated that approximately 17,754 miles of new road construction will occur from the Bureau of Land Management's Record of Decision and Final Environmental Impact Statement for coalbed methane drilling in the Powder River Basin. In addition to coalbed methane development, new road construction is foreseen in the cumulative effects boundary for numerous other activities including private and county timber sales and fuel reduction projects, new oil field development, new subdivisions, and new mineral development. These miles are not quantified but are expected to be inconsequential in comparison to the coalbed methane impact. Of the road construction quantified within the cumulative effects boundary, only 0.05%, or 9 miles, can be attributed to new miles of road on the Bighorn National Forest. The environmental impacts of the Forest roads and the coalbed methane roads are quite different, primarily because of the different ecosystems affected.

Table 3-153. Comparison of cumulative effects.

Category	Less Impact← Relative Impact →More Impact				
Effects related to cross country wheeled motorized travel	No difference between alternatives (All alternatives prohibited off-route wheeled motorized travel)				
Potential for additional motorized opportunities (based on adopted ROS acreage and road construction)	C	B, D-FEIS (similar)	D-DEIS	A	E
Effects related to access based on rights-of-way acquisition	No difference between alternatives				
Effects to travel opportunities based on road closures	No difference between alternatives				

In conclusion, when considered at the broader, regional level (Bighorn and Powder River Basins), the cumulative effects to travel opportunities based on forest plan alternative varies only very slightly, and this variance is based on area of the forest upon which potential additional open routes could be constructed. The most significant effect upon the Forest's ability to manage motorized travel is based on the closure of the remaining "C areas" (areas on the current travel map where wheeled motorized travel can occur off-route) which does not vary by alternative. The social influences on the Bighorn National Forest (population influx, new travel technologies, etc) that will continue to play a dominant role in the level and extent of use of the Forest's system routes will not be dependent on the alternative chosen.

Wild and Scenic Rivers

Introduction

The Wild and Scenic Rivers Act was enacted by Congress to preserve select rivers in a free-flowing condition and to protect other river-related values. As of 2005, 163 river segments and 11,337.7 miles have been afforded protection as a component of the National Wild and Scenic Rivers System (National System) as wild rivers (5,353.2 miles), scenic rivers (2,481.2 miles) and recreational rivers (3,503.3 miles). These nationally recognized rivers comprise a valuable network of natural and cultural values.

For a river to be included in the National System, it must be determined eligible and suitable. To be eligible, a river must be free-flowing and possess one or more outstandingly remarkable river values. Suitability addresses whether identified values should be protected and, if so, whether recommendation of the river to the National System is the best method for protecting identified values.

Suitability involves consideration of a number of factors including land ownership in the area; the land uses that would be affected; public, state and local government interest in the river's designation; estimated costs; and any other issues raised during the planning process.

Rivers are added to the National System by act of Congress or by the Secretary of the Interior. Secretarial designation requires that a river be a part of a state river protection system and the state governor to make application to the Secretary. A recommendation by the Forest Service for any particular river or river segment does not guarantee that Congress will proceed with the recommendation.

Legal and Administrative Framework

The **Wild and Scenic Rivers Act of 1968 (Public Law 90-542), as Amended** established a policy for preserving selected rivers or sections thereof in a free-flowing condition. The intent was to protect water quality of such rivers and to fulfill other vital national conservation measures that would balance the development of water, power and other resources for the benefit and enjoyment of present and future generations.

The **Forest Service Handbook 1902.12 (Chapter 8)** directs the Forest Service, to evaluate rivers for inclusion in the National Wild and Scenic Rivers System through the forest planning process.

Wild and Scenic Rivers Assessment and the Forest Plan Revision Process 11/21/96 is a Washington Office guidance letter regarding the Land and Resource Management Plan revision process and wild and scenic rivers assessment process.

Department of the Interior and Agriculture Interagency Guidelines for Eligibility, Classification and Management of River Areas (USDA and USDI) provides additional guidance to agencies on how to evaluate the eligibility, classification and suitability of rivers

Evaluation Process

The wild and scenic river study process requires determinations to be made regarding a river's eligibility, classification, and suitability. Eligibility and classification represent an inventory of existing conditions. Eligibility is an evaluation of whether a river is free-flowing (without major dams, diversions or channel modifications) and possesses one or more outstandingly remarkable values. These values could include scenery, recreational, geological, fish, wildlife, prehistory, history, or other values. These values should be a unique or exceptional representation for the area studied and must be related to the river or its immediate environment.

If found eligible, a river is analyzed as to its current level of development (water resources projects, shoreline development, and accessibility) and a recommendation is made that it be placed into one or more of three classes: wild, scenic, or recreational. The Wild and Scenic River Act provides the following direction for classifying:

- ◆ **Wild rivers:** those rivers or sections of rivers that are free of impoundments and generally inaccessible except by trail, with watersheds or shorelines essentially primitive and waters unpolluted.
- ◆ **Scenic rivers:** those rivers or sections of rivers that are free of impoundments, with shorelines or watersheds still largely primitive and shorelines largely undeveloped, but accessible in places by roads.
- ◆ **Recreational rivers:** those rivers or sections of rivers that are readily accessible by road or railroad, that may have some development along their shorelines, and that may have undergone some impoundment or diversion in the past.

The final step is to evaluate eligible rivers for suitability. This step includes a discussion of the consequences of designating or not designating the river as a component of the National system in terms of social and economic values, effects on other resources, and effects on private lands and other uses of the area. A suitability analysis is designed to answer the following questions:

- ◆ Should the river's free-flowing character, water quality, and ORVs be protected, or are one or more other uses important enough to warrant doing otherwise?
- ◆ Will the river's free-flowing character, water quality, and ORVs be protected through designation? Is it the best method for protecting the river corridor? In answering these questions, the benefits and impacts of WSR designation must be evaluated and alternative protection methods considered.
- ◆ Is there a demonstrated commitment to protect the river by any nonfederal entities that may be partially responsible for implementing protective management?

Resource Protection Measures

The following guidelines set forth standards for making these determinations on rivers by classification (wild, scenic, or recreational). These guidelines should be applied to the extent of the Bighorn National Forest's jurisdiction over National Forest System lands and easements.

Recommended Wild Rivers

Timber production – cutting trees will not be allowed unless needed to meet management objectives (clearing trails, fire control).

Water supply/Flood control – no major diversion or other structures will be allowed in the channel or river corridor.

Mining – Mining activity on an agency-identified study river is subject to regulations in 36 CFR 228. Mineral removal shall be prohibited and these areas are designated as administratively unavailable for new oil and gas leasing.

Road construction – no new roads and no motorized travel will be allowed outside designated routes.

Recreation development – major public use sites (campgrounds, administrative buildings) are located outside the wild river corridor.

Utilities – new transmission, gas, and water lines are discouraged. Where no reasonable alternative exists, additional or new facilities should be restricted to existing rights-of-way.

Recommended Scenic Rivers

Timber production – A range of vegetation management and timber harvest practices are allowed, provided that such practices are designed to protect, restore, or enhance the river environment, including the long-term scenic character.”

Water supply/Flood control – major diversions and flood control dams are prohibited.

Mining – Mining activity on an agency-identified study river is subject to regulations in 36 CFR 228. Mineral removal shall be prohibited and these areas are designated as administratively unavailable for new oil and gas leasing.

Road construction – roads may occasionally bridge the river. Short, conspicuous road stretches or longer, inconspicuous, well-screened road stretches could be allowed.

Recreation development – public use sites (moderate-sized campgrounds, administrative facilities) are allowed, provided they are outside the river floodplain and screened from view.

Utilities – new transmission, gas, and water lines are discouraged. Where no reasonable alternative exists, additional or new facilities should be restricted to existing rights-of-way.

Recommended Recreation Rivers

Timber production – A range of vegetation management and timber harvest practices are allowed, provided that such practices are designed to protect, restore, or enhance the river environment, including the long-term scenic character.”

Water supply – existing low dams, diversion structures, rip-rap, and other minor structures are allowed provided the river stays generally natural in appearance. New structures are prohibited.

Mining – Mining activity on an agency-identified study river is subject to regulations in 36 CFR 228. Mineral removal shall be prohibited and these areas are designated as administratively unavailable for new oil and gas leasing.

Road construction – parallel roads or railroads could be constructed on one or both riverbanks. There can be several bridge crossings and numerous river access points.

Recreation development – campgrounds and picnic areas may be established close to the river. However, recreational classification does not require extensive recreation development.

Structures – small communities as well as dispersed or cluster residential developments are allowed. New structures are allowed for both habitation and for intensive recreation use.

Motorized travel – this activity, on land or water, may be permitted, restricted, or prohibited. Controls will usually be similar to surrounding lands and waters.

Utilities – new transmission, gas, and water lines are discouraged. Where no reasonable alternative exists, additional or new facilities should be restricted to existing rights-of-way.

AFFECTED ENVIRONMENT

The Tongue and Little Bighorn Rivers were identified as eligible for potential inclusion into the NWSRS in the 1985 Forest Plan. In the 1989 Wild and Scenic River Study Report and Final EIS on the Little Bighorn River, 19.2 miles of river were found suitable (USDA 1989). The area was recommended for Congressional designation in August 1990, however Congress has not acted on this recommendation. Both the Little Bighorn and Tongue Rivers remain within the 1985 Plan’s Management Area 10D (wild and scenic management area; the 1985 Plan did not differentiate between wild and scenic river classifications). Their unique qualities are safeguarded by specific standards and guidelines.

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AFFECTED ENVIRONMENT & ENVIRONMENTAL CONSEQUENCES

In 2001, the Bighorn National Forest conducted an initial screening process of all rivers on the Forest for consideration of potential eligible rivers utilizing the following inventory lists:

- ◆ Nationwide Rivers Inventory list that was updated in April 2000.
- ◆ 1988 American Rivers' "Outstanding Rivers List."
- ◆ December 2000 Sierra Club correspondence.

After the list was completed, an initial determination of free-flowing condition was made and the rivers were divided into homogenous sections for analysis on landform, resources, and land uses. Each of the previously described steps for determining outstandingly remarkable values, classification, and suitability were completed and are documented in FEIS Appendix D, Wild and Scenic Rivers. Appendix D also contains individual descriptions of the rivers. The following table displays the results of this inventory and evaluation of streams on the Forest for eligibility.

Table 3-154. Wild and scenic river evaluation for the Bighorn National Forest.

River/Stream	Eligible Miles	Outstandingly Remarkable Values	Potential Classification Class	Miles	Suitable Miles
Little Bighorn	20.01	Scenery	Wild Scenic	15.9 4.11	20.01
Tongue	32.85	Scenery Recreation Fisheries	Wild Scenic Recreational	8.10 3.00 21.75	32.85
Piney	Not eligible				
South Rock	16.28	Scenery Geology History	Wild Scenic	13.04 3.24	16.28
Tensleep	6.82	Scenery Geology	Scenic	6.82	No
Crazy Woman	4.47	Scenery Vegetation	Scenic	4.47	No
Cedar	8.5	Fisheries Scenery	Wild	8.50	No
Lodge Grass	Not eligible				
Porcupine	6.25	Scenery Cultural	Wild	6.25	6.25
Shell	Not eligible				
Paintrock	14.85	Scenery Geology	Wild Scenic	9.05 5.8	14.85
Medicine Lodge	Not eligible				
Total Miles	110.03			110.03	90.24

ENVIRONMENTAL CONSEQUENCES

Recommendations by Alternative

The following table summarizes Wild and Scenic River recommendations by alternative, classification, and miles. As displayed in the previous table, Piney Creek, Lodge Grass Creek, Shell Creek, and Medicine Lodge did not meet the eligibility criteria.

For the Revised Plan, Alternative D-FEIS is similar to Alternative D-DEIS in that the Little Bighorn was recommended in its entirety, based on the study that was submitted to Congress regarding this river in 1989. In Alternative D-DEIS, there was no recommendation for the Tongue River. Alternative D-FEIS recommends a stretch of the Tongue River from the Forest boundary up to near U.S. Highway 14A west of Burgess Junction. The remainder of the Tongue River along U.S. Highway 14A upstream of the recommended section in lies within Management Area 4.2, which will adequately protect the recreational outstanding remarkable values associated with the river.

Table 3-155. Wild and scenic river recommendations by alternative in river miles.

River/Stream	Classification	Alternatives					
		A	B	C	D-DEIS	D-FEIS	E
Little Bighorn	Wild	20.01	15.9	15.9	15.9	15.7	15.9
	Scenic		4.11	4.11	4.11	4.3	4.11
Tongue	Wild		8.1	8.1	NR	4.9	NR
	Scenic	32.85				6.5	
	Recreational		21.75	21.75		7.5	
Crazy Woman	Scenic	NR	NR	NR	NR	NR	NR
Tensleep	Scenic	NR	NR	NR	NR	NR	NR
South Rock	Wild	NR	13.04	16.28	NR	NR	NR
	Scenic		3.24				
Porcupine	Wild	NR	6.25	6.25	NR	NR	NR
Paintrock	Wild	NR	9.05	9.05	NR	NR	NR
	Scenic		5.8	5.8			
Cedar	Wild	NR	NR	NR	NR	NR	NR
<i>Total by Class</i>	<i>Wild</i>	<i>20.01</i>	<i>52.34</i>	<i>55.58</i>	<i>15.9</i>	<i>20.6</i>	<i>15.9</i>
	<i>Scenic</i>	<i>32.85</i>	<i>13.15</i>	<i>9.91</i>	<i>4.11</i>	<i>10.8</i>	<i>4.11</i>
	<i>Recreational</i>		<i>21.75</i>	<i>21.75</i>		<i>7.5</i>	
Total		52.86	87.24	87.24	20.01	38.9	20.01

Note: Mileage based on GIS data – may be slightly different than mileage shown in prior table due to increased accuracy.

NR = Not recommended in this alternative

General Effects

Alternatives B and C provide the greatest number of miles of recommended wild and scenic (87.24), followed by Alternative A (52.86 miles) and Alternative D-FEIS (38.9 miles). Alternatives D-DEIS and E have fewer (20.01) recommended miles.

The river management prescriptions allocated to these river corridors place management constraints on the type of activities that can occur within the river corridors. As appropriate, based on alternative, these rivers are placed in Management Areas 1.5, 3.4, or 4.4 (wild, scenic, recreational) to protect their existing characteristics and values. The following table lists the three management area allocations by alternative.

Table 3-156. Acres of Management Areas 1.5, 3.4, and 4.4, by alternative.

Alternative	Management Areas			Total
	1.5 (Wild)	3.4 (Scenic)	4.4 (Recreation)	
C	22,925	4,817	10,900	38,642
B	21,715	5,815	10,901	38,431
A	13,217	17,110	0	30,327
D-FEIS	15,632	6,188	3,457	25,277
D-DEIS	10,251	2,887	74	13,212
E	10,251	2,887	0	13,138

Note: Acreages may vary slightly due to information derived from GIS data source.

Direct and Indirect Effects

Effects from Minerals Management: Anticipated effects from mineral management would be low in all alternatives, in proportion with the amount of miles designated, as shown above. Mineral potential is low for locatable minerals (gold, silver, etc.) and very low for leasable minerals (oil and gas) within and around all wild and scenic river corridors. There are no current permits or operating plans for minerals exploration within the corridors. Salable mineral such as dolomite and limestone are present and could potentially be used for construction purposes, however, because of the inaccessibility of these reserves, they have not been utilized to any extent in the past.

An agency-identified study river is not withdrawn from either locatable or leasable mineral entry. The applicability of the 1872 Mining Act, as amended, is unaffected unless the area is withdrawn from mineral entry under some other statutory authority (e.g., wilderness) or the Forest Service recommending to the Bureau of Land Management that an area be withdrawn from mineral entry. The latter requires a detailed analysis of mineral potential/area's values and an environmental assessment as well as concurrence by the Department of the Interior.

If a particular river were to be ultimately designated, the Wild and Scenic Rivers Act affects minerals management/development in several ways:

- ◆ Subject to valid existing rights (i.e., subject to existing mining claims and mineral leases), the minerals located on federal lands within the bed or banks or ¼-mile of the banks of any designated *wild* river are withdrawn from all forms of appropriation under the mining laws and from the operation of the mineral leasing laws.
- ◆ Subject to valid existing rights (i.e., subject to mining claims where the claimant has filed a proper patent application and paid the required fees prior to the river's designation), mining claimants may only obtain title to the mineral deposits and such rights to the use of the surface and surface resources as are reasonably required for prospecting or mining.
- ◆ The act requires regulations be developed to govern mining and mineral leasing activities within Wild and Scenic River corridors. While the Secretary of Agriculture has not issued these regulations, the Forest Service uses its existing regulations (36 CFR 228) to meet, to the extent possible, the nondegradation standard of Section 10(a).

There would be no anticipated adverse effects from mineral material removal as mitigation measures would be included in project level plans.

Effects from Livestock Grazing and Rangeland Management: Effects from livestock grazing are expected to be minimal under any recommended river designation. Although most wild and scenic river corridors have some acres of range allotments within them, standards and guidelines are in place to manage for desired conditions as identified in allotment management plans.

Effects from Recreation Management: Effects from recreational use and management within designated river segments are anticipated to be low. Although designated river segments may be used for camping, canoeing, hiking, and other anticipated activities, the anticipated impact of these activities on the overall river itself is expected to be minimal since they are generally low intensity.

Recreational users expect to experience primitive conditions within wild river segments, and so recreation development would not be allowed. Recreational development would be allowed under recreational and scenic classification; however, the development would be carried out in such a way as to not adversely affect the reasons for scenic river designation. There are no plans for any development within any of these corridors at this time.

Additional effects (e.g., trash not disposed of properly and human-caused fires), can be expected but are anticipated to be low. Fishing and hunting would not be prohibited under a wild or scenic classification. Fishing and hunting are regulated under state laws.

Effects from Travel Management: Motorized travel would be prohibited in recommended wild rivers corridors (Management Area 1.5). Effects from nonmotorized use and permitted motorized use are anticipated to be low in recreational and scenic river segments. Within recreational and scenic segments, road building or river crossing developments to accommodate motorized traffic would be allowed, subject to protecting

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the river's free-flowing condition. Construction of such developments might be more costly as design specifications seek to reduce visual impacts and the number of river crossings. If motorized use, such as recreational vehicle use, were shown to be causing adverse environmental effects, travel-closure orders may be applied at the discretion of the District Ranger.

Even though some eligible river segments, especially those classified as wild, are very remote and quite inaccessible, the Wild and Scenic Rivers Act does not prohibit motorized use within designated segments. Because of the remote nature of the Bighorn National Forest's wild river corridors (versus scenic), the volume of motorized traffic by land vehicles would be extremely low.

Nonmotorized access within designated river segments would not be restricted. Floating the river corridors or hiking in on foot or horseback would likely be the primary ways to access wild river segments.

In addition, motorized boats, jet skis, hovercraft and other types of water-bound craft are allowed in scenic or recreational river segments, consistent with Congressional intent and the river management objectives as outlined in the enacting legislation and the Comprehensive River Management Plan. Generally these types of uses are prohibited in wild river corridors to protect recreation experience and other resource values and may be permitted, prohibited or restricted in scenic or recreational as necessary to protect values.

Motorized use would be prohibited in those river segments within established wilderness areas.

Effects from Scenery Management: Positive effects on wild and scenic rivers are expected from scenic resource management, in proportion with the amount of miles designated as shown in the general effects section. Management activities will not dominate the scenic qualities of the area.

Recommended river segments will be managed for their scenic resources according to their recommendation categories, with viewshed protection for wild and scenic rivers, and river corridor protection for recreation rivers. The scenic integrity objectives are generally high or moderate.

Effects from Timber Management: Tentatively suited acres within the 1.5, 3.4 and 4.4 management area prescriptions were not considered part of the suited base. Timber management has the potential to change the character of rivers and the adjacent areas, primarily with regard to visual aspects. Within eligible wild river corridors, the cutting of trees will only occur if needed to meet management objectives (such as trail clearing or fire control). Scenic and recreation river corridors allow vegetative treatment of timber stands, as long as the treatment meets recreation or scenery objectives.

Effects from Management of Special Uses: Construction of a major water resources project (e.g., dam, diversion structure) is likely to affect a river's free-flowing condition and therefore its eligibility for consideration as a wild and scenic river. Water resources projects of smaller size and with limited adverse effects to free-flowing character and or

outstanding values might not eliminate the river from future consideration but may affect its classification. No large-scale water resources projects are currently projected or anticipated. To the extent of Forest Service authority, water resources projects are subject to review and must protect the river's free-flowing condition, outstandingly remarkable values, and classification.

There are several existing recreation residences in the northeast corner of the Little Bighorn Wild River management area. These recreation residences are compatible with Management Area 1.5 per the 1989 study submitted to Congress which states:

“Existing structures, such as the special-use permitted recreation residences and the livestock fences in segment A, would be allowed because they are consistent with the essentially primitive and natural values of the area. New structures would not be allowed except in rare instances to achieve management directives, such as fisheries enhancement programs.”

An annual trail run in the Little Bighorn and Tongue River canyons is a popular event. This would continue to be an allowed use in both the Little Bighorn and Tongue River areas based on their compatibility as a nonmotorized event.

On designated rivers, Federal Energy Regulatory Commission-licensed facilities are prohibited within a designated corridor. Other federally assisted water resources projects within a designated river corridor are evaluated as to their potential “direct and adverse effect” on the values for which the river was designated. Proposed water resource projects above, below, or on a stream tributary to a designated river are evaluated as to their potential to influence the designated river area or unreasonably diminish the scenic, recreational, fish or wildlife values of the designated river.

Cumulative Effects

The cumulative effects table at the beginning of this chapter includes the list of past, present and reasonably foreseeable future activities that were considered with regard to cumulative effects to Wild and Scenic Rivers. The next 15 years are considered the time span for “reasonably foreseeable future” cumulative effects. The area considered for cumulative effects consists primarily of the 4-county area.

In terms of past actions, the Tongue and Little Bighorn Rivers were identified as eligible for potential inclusion into the National Wild and Scenic River System in the 1985 Forest Plan. In the 1989 Wild and Scenic River Study Report and Final EIS on the Little Bighorn River, 19.2 miles of river were found suitable. The area was recommended for Congressional designation in August 1990, however Congress has not acted on this recommendation. During the last planning period, both the Little Bighorn and Tongue Rivers remained within the 1985 Plan's Management Area 10D (wild and scenic management area - the 1985 Plan did not differentiate between wild and scenic river classifications), their unique qualities safeguarded by specific standards and guidelines.

On January 2000, the Federal Energy Regulatory Commission dismissed a proposed hydropower project on the Little Bighorn River.

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As part of their evaluation of the Buffalo Resource Management Plan Area, the Bureau of Land Management (BLM) completed a wild and scenic rivers review of all BLM-administered public land along waterways within the Buffalo Planning area, culminating in 1994. This review was to determine if any BLM-administered lands meet the wild and scenic rivers eligibility criteria and suitability factors. It was determined that of 120 waterways in the BLM-administered planning area, four waterways met the test of eligibility. Of those four waterways, only the Middle Fork of the Powder River met both the additional standard of suitability and will be managed as such by the BLM (USDI BLM 2002).

Additional designated river segments in Wyoming may create new regional attractions for visitors (Power 2002). The following table lists the past and potentially foreseeable river designations that were considered in the cumulative effects analysis. This would be greatest in Alternatives B and C (since they recommend the greatest number of river miles), followed by A and D-FEIS, D-DEIS, and E although the level of visitation on the Bighorn National Forest would be partly dependent on ease of access (USDA Forest Service 1989) so unless a recommended river stretch is easily accessible, recommendation is not likely to have perceptible effects upon visitation.

Although the effects of non-designation may not change recreation or tourism in or near the designated river segments, non-designation may represent a lost opportunity to protect stream characteristics that are unusual to the region. This is most likely in Alternatives D-DEIS and E (since they recommend the least number of river miles), followed (in order) by D-FEIS, A, B and C.

Table 3-157. Past and potentially foreseeable river recommendation used in the cumulative effects analysis.

Previously designated rivers in the region			
River	Location	Date designated	Category
Clark's Fork of the Yellowstone River	Shoshone NF, northwest Wyoming	11/28/1990	20.5 miles (wild)
Missouri River	North central Montana	10/12/1976	64 miles (wild), 26 miles (scenic), 59 miles (recreation)
Potentially foreseeable river designations in the region			
River	Location	Comments	
Upper Snake River	Bridger-Teton NF and western Wyoming	May 27, 2005 statement of support for consideration of utilizing the Wild and Scenic Rivers Act for the Upper Snake issued by U.S. Senator Craig Thomas to coalition of outdoor and recreation groups meeting at the Summit on the Snake	

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South Fork of Paintrock Creek	West of Bighorn National Forest boundary, Big Horn County	Determined suitable by BLM, 2002
Laddie Creek	West of Bighorn National Forest boundary, Big Horn County	Determined suitable by BLM, 2002
Medicine Lodge Creek (non Bighorn NF)	West of Bighorn National Forest boundary, Big Horn County	Determined suitable by BLM, 2002
Porcupine Creek (non Bighorn NF)	Adjacent to northwest boundary of Bighorn National Forest, Big Horn County	Determined suitable by BLM, 1993
Little Bighorn River	Northern Bighorn National Forest	Determined suitable in Revised Plan, 2005
Tongue River	Northern Bighorn National Forest	Determined suitable in Revised Plan
South Rock Creek	East central Bighorn National Forest	Determined suitable in Revised Plan
Porcupine Creek	Northwest Bighorn National Forest	Determined suitable in Revised Plan
Paintrock Creek	West central Bighorn National Forest	Determined suitable in Revised Plan

Wilderness

Introduction

The Bighorn National Forest surrounds and administers the Cloud Peak Wilderness. The wilderness totals 189,039 acres. Congressionally designated wilderness is one type of special area designation on the forest. The *Wilderness Act of 1964* established the National Wilderness Preservation System. It mandates that these areas are to be “administered for the use and enjoyment of the American people in such a manner as will leave them unimpaired for future use and enjoyment as wilderness.” Wilderness is part of the National Forest multiple use management mission. Wilderness provides opportunities for solitude and for primitive and unconfined recreational experiences. Wilderness is important for maintenance of species diversity, protection of air quality and watersheds, scientific research, and various social values including solitude.

Legal and Administrative Framework

The Wilderness Act of 1964 (P.L. 88-577) directed the Secretary of Agriculture to initiate reviews of the existing primitive areas and to submit recommendations regarding their future to Congress within 10 years of the act’s passage. Section 2 of the Wilderness Act defines wilderness and sets forth policy and implications for wilderness designation. Lands are designated as wilderness ... “in order to assure that an increasing population, accompanied by expanding settlement and growing mechanization, does not occupy and modify all areas within the United States and its possessions, leaving no lands designated for preservation and protection in their natural condition.”

The Wyoming Wilderness Act of 1984 (P.L. 98-550) designated the Cloud Peak Wilderness.

Congressional Grazing Guidelines (Sec. 108, P.L. 96-560, H.R. Report 96-617 dated 11/14/79) clarifies the Congressional intent that livestock grazing will be permitted to continue in national forest wilderness areas, when such grazing was established prior to classification of an area as wilderness.

Resource Protection Measures

The Wilderness Act established the National Wilderness Preservation System for the purposes of providing an enduring wilderness resource for the Nation. Standards and guidelines included in the plan are designed to meet the intent of the Wilderness Act. The standards and guidelines for wilderness work to protect the wilderness resource from degradation. Monitoring is conducted to evaluate impacts and maintain wilderness character.

The Forest Service's 10 year wilderness stewardship challenge was developed in 2004. It identifies 10 critical elements for wilderness stewardship: planning for the natural role of fire in Wilderness; treatment of non-native, invasive plants; monitoring and establishing a baseline for air quality; wilderness education activities; protection of opportunities for solitude or primitive and unconfined recreation; recreation site inventory; outfitters and guides modeling appropriate wilderness practices, forest plan direction to prevent resource degradation; wilderness data collection, storage, and analysis; and a baseline workforce. The 10 elements and their associated, measurable outcomes support wilderness stewardship for the next generation.

A new national framework for monitoring selected conditions related to wilderness character was published in April 2005. A technical guide with monitoring protocols is planned and it will be evaluated for incorporation into the monitoring plan when it is available.

AFFECTED ENVIRONMENT

Introduction

Since the Wilderness Act of 1964, the National Wilderness Preservation System (NWPS) has grown dramatically. As of 2004, Congress had designated more than 106 million acres of federal public land as wilderness. Numerous bills are pending in Congress that would create millions of acres of new wilderness areas in national forests, national parks, national wildlife refuges, and land administered by the Bureau of Land Management (BLM). However, there are no pending bills for wilderness designation in the State of Wyoming.

The wilderness system has been built through enactments of approximately 104 Wilderness bills, typically establishing wilderness areas in a particular state. The Wilderness Act allows additional undeveloped and unroaded lands to be added to the NWPS. The Forest Service initially inventories wilderness potential by identifying roadless areas of 5,000 acres or larger. There are three tests applied to roadless areas before they are considered for wilderness recommendation: capability, availability, and need.

Nationally in the NWPS, there are 67 wildernesses encompassing approximately 106 million acres. This is approximately 4.7% of the total U.S. land mass. The Forest Service manages approximately 29 million acres in 406 wilderness areas. This is 17% of all National Forest System land.

In Wyoming there are a total of 3.1 million acres of designated wilderness in 15 National Forest wildernesses. Wilderness covers approximately 5% of the state's area. Wyoming wildernesses administered by the Forest Service represent about three percent of the area in the NWPS.

Physical Setting

The Cloud Peak Wilderness is the only designated wilderness area on the Bighorn National Forest. The wilderness contains 189,039 acres covering 17% of the Forest and comprising 6% of Wyoming's 3.1 million acres of wilderness. There are no private inholdings within the Cloud Peaks Wilderness. There have been no changes to the size of the Cloud Peak Wilderness area since passage of the Wyoming Wilderness Act on October 30, 1984.

The interior of the wilderness landscape is dominated by a spine of granitic peaks, the highest of which is Cloud Peak at 13,175 feet in elevation. The lowest point of elevation in the wilderness is Shell Creek at 8,000 feet.

Average annual precipitation in the wilderness is 30 inches, falling mostly as snow, although many high elevation areas receive significantly more. The headwaters of streams flowing in the Bighorn, Little Bighorn, and Powder River basins originate in the Cloud Peak Wilderness.

Table 3-158. Geologic landtype associations in the Cloud Peak Wilderness.

Description	% of total
Alpine Mountain Slopes and Ridges (granitic)	45%
Glacial Cirquelands (granitic)	32%
Glacial / Tertiary Terrace Deposits (granitic)	9%
Gentle Mountain Slopes (granitic)	13%
Steep Mountain Slopes (granitic)	<1%
Breaklands (sedimentary)	<1%
Mountain Slopes (sedimentary)	<1%

Source: GIS Inventory

The wilderness includes the highest elevation areas of the Forest. Approximately 47% of the Wilderness is in the alpine climate zone, 30% is sub-alpine, and 22% is montane/sub-alpine.

The Cloud Peak Wilderness is a Class II air quality area. The wilderness areas created prior to the 1977 are Class I air quality areas where land managers have certain responsibilities to review permit applications for new air pollution sources. Wilderness areas created by later acts including the Cloud Peak (1984) are Class II air quality areas. Air quality monitoring began in 1992 and continues to the present. Visibility – one air quality indicator – is very good in the Cloud Peak. (See the section of the FEIS on air for more information.) The Forest and partners are also engaged in lake water sampling for chemical indicators of changes in water quality from human sources. A change in pH as a result of acid precipitation is an important indicator. To date, no change in lake water pH has been noted. The wilderness lakes are vulnerable to acidification because the granitic geology of the area has a low acid neutralization capability.

Biological Setting

Vegetative composition of the wilderness is shown in the following table.

Table -3-159. Vegetative composition of the Cloud Peak Wilderness.

Cover type	% of Total
Forb/grasses	13%
Bare/rock	42%
Shrubs (primarily willow)	1%
Aspen	<1%
Douglas Fir	<1%
Lodgepole	14%
Spruce Fir	30%

Source: GIS Inventory

Provisions in the Wilderness Act of 1964 specify that grazing be allowed to continue where it is established prior to designation. There are 7,884 acres of suitable rangeland (within active and vacant allotments) inside the wilderness. There is currently no grazing by sheep under permit in the wilderness. Grazing by recreation stock (horses and llamas) is substantial in some areas of the wilderness.

Several sensitive species that occur or potentially occur in the wilderness are described in detail in the section of the FEIS on biodiversity. None of these species are found exclusively within the wilderness; they are found in suitable habitat outside the wilderness as well. Rare plants and animals found in the wilderness include the American marten, Bighorns pika, Kotzebue's grass-of-parnassus (*Parnassia kotzebuei*), northern goshawk, northern leopard frog, and bighorn sheep. Wolverines may travel through the wilderness, although none are known to inhabit it.

The Cloud Peak Wilderness abounds with lakes and streams. Some of the larger lakes are stocked by the state of Wyoming. This increases recreational fishing opportunities for visitors. It also raises concerns among some sectors of the public and the Forest Service as to whether or not stocking carries the potential for a loss of wilderness values. The majority of lakes inside the wilderness are fishless. Additional information on fish and fish stocking in the wilderness is in the Aquatics section of the FEIS.

Wilderness lakes are extremely sensitive to acid rain deposition, because the granitic parent material supplies little buffering capacity. Monitoring of water and air quality is ongoing, in partnership with the state of Wyoming.

The Cloud Peak Wilderness has not been heavily impacted by fire over time. Much of the area within the current wilderness boundary consists of high elevation sites that are primarily rock and bare soil. Those areas that are vegetated tend to be wet sites, such as high alpine meadows that are too wet to burn. Wildfire is estimated to affect parts of the vegetated wilderness every 100 to 200 years.

New and expanding populations of invasive plant species in the Cloud Peak Wilderness are of a particular concern since these weeds can out-compete native plants and compromise both the resource values and the wilderness character. On-going management approvals are in place for noxious weeds. Ox-eye Daisy (*Chrysanthemum leucanthemum*) and Canada thistle (*Cirsium arvense*) are examples.

Recreation

The Cloud Peak Wilderness is a popular recreation destination among visitors to the Bighorn National Forest.

The Forest Service uses the Recreation Opportunity Spectrum (ROS) to describe the recreation settings available in relation to the opportunities for recreation experiences. These opportunities are separated into (ROS) classes. Two classes – primitive (P) and semi-primitive nonmotorized (SPNM) - have been inventoried in the Cloud Peak Wilderness. The primitive ROS class includes areas that are primarily unmodified. Users have a very high probability of experiencing solitude, freedom, closeness to nature, tranquility, self-reliance, challenge, and risk in primitive areas and a low likelihood of encountering other users. The semi-primitive non-motorized ROS class includes areas offer a natural appearing environment with a high probability of experiencing solitude, challenge, and risk. In semi-primitive nonmotorized areas there is a low probability of encountering others, but there may be evidence of other users. Access and travel is by foot or horse on trails or cross country in both ROS classes.

Table 3-160. ROS inventory and management area allocations in the Cloud Peak Wilderness.

ROS Inventory			Forest Plan Management Areas		
	Acres	Percent*	Management Area**	Acres	Percent*
Primitive (P)	137,708	72%	1.11 Pristine Wilderness	130,797	68%
Semi-Primitive Nonmotorized (SPNM)	54,189	28%	1.13 Semi-Primitive Wilderness	61,100	32%
Total Acres	191,897		Total Acres	191,897	

Source: GIS Inventory

* Percent is the percent of total acres in the Cloud Peak Wilderness.

**The "1.12- Primitive" management area category was not used in the Cloud Peak.

The table shows the acres inventoried in each ROS class and the acres allocated to each management area. Although the inventory and management area definitions are similar, different mapping protocols were used. The future management of the Cloud Peak Wilderness will be based on the management areas, standards, and guidelines in the Revised Plan. These are very similar to those in the 1998 the Forest Plan amendment on wilderness management. The recreation use regulations for the Cloud Peak Wilderness were updated by the 1998 decision.

Recreation visitor day (RVD) use since 1993 is shown below. An RVD is defined as any recreational use of the forest which results in 12 visitor hours. The RVD numbers reflect Cloud Peak required registration data, which includes “number of people in party” and “length of stay” data. Based on forest monitoring, registration compliance levels are high and the data is reliable. Annual use has averaged about 63,000 RVDs. There is a declining trend in the past four years. Over the past 12 years, the RVD trend is a decline of 1.3% per year. Many variables influence use in a particular year or set of years; local weather and a variety of socioeconomic conditions are among the influences on a decision to visit the wilderness.

Table 3-161. Cloud Peak Wilderness visitation (RVDs).

Year	RVDs
1993	67,700
1994	77,400
1995	55,000
1996	67,000
1997	54,000
1998	61,000
1999	65,000
2000	70,500
2001	70,000
2002	62,500
2003	55,000
2004	47,500

The following table illustrates the mix of recreation travel in the Cloud Peak. The season of accessibility for hiking and horse use runs from June 15 to September 30 with average snow conditions. .

Table 3-162. Travel modes in the Cloud Peak Wilderness.

Method	FY 94	FY 95	FY 96	FY 97	FY 98	FY 99	FY00	FY 01
Hiking	87%	93%	90%	89%	86%	90%	90%	90%
Horseback	12%	7%	10%	11%	14%	10%	10%	10%
Ski	<1%	<1%	<1%	<1%	<1%	0	0	0
Snowshoe	<1%	<1%	<1%	0	0	0	0	0

Between October 2000 and September 2001, the National Visitor Use Monitoring Survey was conducted on the Bighorn National Forest. Some findings of the survey relate to wilderness visits. The average length of stay for visitors to the wilderness was 35 hours,

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compared with a forestwide average of 16 hours. The wilderness visitor was, on average, older than the forestwide visitor and came from a wider geographic area.

Visitors staying overnight in wilderness must camp. Most camping occurs around lakes. During the summer seasons of 2001 and 2002 campsite conditions, including campsite density, were monitored. Campsite density data was compared to forest plan guidelines in a report compiled by Craig Cope and dated November 18, 2002. Seventy percent or 28 of the 40 lakes surveyed in the 1.13 – Semi-Primitive Wilderness management area exceeded campsite density guidelines. One hundred percent or 15 of the 15 lakes surveyed in the 1.11 – Pristine Wilderness management area, exceeded campsite density guidelines. Campsites were inventoried in 1996 and in 2000. The Cole method was used to assess the area of bare ground where vegetation was lost. An increase in the area of bare ground of nearly 30% was documented. Both the number (density) and size (bare ground) of campsites indicate that current levels of human use are having an impact on the wilderness resource.

The National Visitor Use Monitoring Survey collected visitor satisfaction information pertaining to how crowded the wilderness felt to visitors. This is shown in the following table. Opinions related to General Forest Areas are included for comparative purposes. The perception of crowding is an indicator of social conditions in the wilderness. It relates to visitor satisfaction and is one indicator of the relationship between wilderness supply and demand.

Table 3-163. Visitor perceptions of crowding in the Cloud Peak Wilderness (percent of site visits).

Perception of crowding	Wilderness	General Forest Areas*
10 (overcrowded)	0.0%	19.6%
9	0.0%	1.5%
8	0.0%	0.4%
7	12.5%	1.9%
6	0.0%	31.5%
5	25.0%	14.9%
4	12.5%	1.8%
3	37.5%	11.7%
2	12.5%	10.0%
1 (hardly anyone there)	0.0%	6.7%

*General forest area is undeveloped area outside of developed sites and special areas.

Commercial opportunities for permitted outfitter and guide services are at the capacity determined in a study undertaken in 1986 to implement the 1985 Forest Plan. There are currently 21 outfitters providing a range of services in the Cloud Peak Wilderness during summer and fall seasons.

ENVIRONMENTAL CONSEQUENCES

General Effects

In all alternatives, the existing Cloud Peak Wilderness acres remain the same. Effects on the Cloud Peak Wilderness are similar under all alternatives, because management areas, standards, and guidelines are identical. The following discussion of general effects on wilderness addresses recommendations for additional wilderness designation in inventoried roadless areas. See the Roadless Area section of this chapter for a discussion of the affected environment. Detailed discussion of the individual, inventoried roadless areas is in FEIS Appendix C. Recommendation of new areas for wilderness has the potential effect of protecting more wilderness resource.

Alternatives A, B, D-DEIS, and E do not recommend any acres for wilderness designation. Alternative C recommends five areas, Rock Creek, Walker Prairie, Little Bighorn, Devil Canyon and Medicine Lodge (a total of 104,388 acres), for wilderness designation. Alternative D-FEIS recommends one area, Rock Creek, with (33,857 acres) for wilderness designation. Congressional action is required to designate a new wilderness. A forest plan allocation to M.A. 1.2 Recommended for Wilderness is an administrative action.

The southern portion of the Rock Creek inventoried roadless area is not included in D-FEIS. This improves manageability by eliminating the irregular boundary and intrusions caused by Forest Roads 365, 388, and 396. Impacts associated with U.S. Highway 16 on the south border of the roadless area and water diversions into French Creek are also removed from the area. The Rock Creek 1.2 MA is contiguous with the Cloud Peak Wilderness and Congressional designation would enlarge the existing wilderness for a total of 222,896 acres.

The upper portion of the Medicine Lodge inventoried roadless area is not included in the recommendation. Lower Medicine Lodge Lake was excluded because a full range of recreation management tools are important in protecting lake shores over the long-term. Three developed campgrounds are located in the vicinity. The 5,989-acre Medicine Lodge 1.2 MA recommended in Alternative C is contiguous with a BLM Medicine Lodge area, where about 3,600 acres were recommended for wilderness designation in 1990. Congressional action to designate both areas would create a wilderness of about 9,589 acres.

Direct and Indirect Effects

Effects from Recreation Use and Management: Alternative C and D-FEIS recommend new areas for wilderness designation. Alternatives A, B, D-DEIS, and E do not include areas recommended for wilderness designation. Designation of new wilderness may change patterns of recreation use and reduce pressure in the existing wilderness. Motorized and mechanized travel on trails and unclassified roads would be prohibited in areas recommended for wilderness designation. To the extent it currently occurs in the recommended areas, ATV, motorcycles, snowmobile, and bicycle use would be displaced.

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The average elevation in each of the areas recommended for wilderness designation in Alternative C and D-FEIS is lower than the average elevation of Cloud Peak Wilderness. New areas would generally have a longer snow-free season and a longer season of use.

Recreation impacts to water quality in the wilderness are the same as the impacts to water quality across the Forest: increased runoff and sediment into streams as a result of both trail and off-trail activities; stream bank erosion and channel instability as a result of repeated camping near streams; and water contamination from human or animal waste. Overall, wilderness recreation on and off-trails disturbs a relatively small portion of the watershed. However, short-term acute recreation impacts around heavily used lakes and streams are a concern.

The current ROS inventory (circa 1998) of semi-primitive nonmotorized (SPNM) recreation opportunities includes 25% of the forest (278,105 acres). Approximately 222,484 acres is outside designated wilderness. Alternative C would recommend adding 24,181 acres of primitive area and 75,458 acres of semi-primitive non-motorized area from the current inventory to the wilderness system. Alternative D-FEIS would recommend adding 16,040 acres of primitive area and 11,649 acres of semi-primitive non-motorized area from the current inventory to the wilderness system.

By providing nonmotorized opportunities outside wilderness, social and physical impacts inside wilderness may decrease. The numbers in the following tables are based on the ROS guideline for each management area (M.A.) except for those in MA 1.2 and MW. The numbers for MA 1.2 and MW are based on the inventoried ROS because ROS areas are not prescribed for those management areas. Management areas that allow for a combination of SPNM or SPM are not included.

Based on the management area allocations, Alternative C would prescribe the most SPNM acres outside wilderness and recommended wilderness, followed by B, D-DEIS, D-FEIS, and A. Alternatives E would prescribe the least SPNM outside of wilderness and recommended wilderness.

Table 3-164. Acres and percents of semi-primitive nonmotorized recreation (SPNM) opportunity by alternative.

	Alt. A	Alt. B	Alt. C	Alt. D-DEIS	Alt. D-FEIS	Alt. E
Total acres of SPMN	159,129	224,491	297,396	164,490	169,103	128,722
Percent of forest in SPNM	14%	20%	27%	15%	15%	12%
SPNM acres in wilderness (M.A. 1.13)	61,098	61,094	61,100	61,100	61,100	61,090
SPNM acres recommended for wilderness			75,458		11,649	
Total SPNM acres outside wilderness (M.A. 1.13) and recommended for wilderness (M.A. 1.2)	98,031	163,397	160,838	103,390	96,354	67,632

	Alt. A	Alt. B	Alt. C	Alt. D-DEIS	Alt. D-FEIS	Alt. E
Percent of forest in SPNM outside of wilderness and recommended for wilderness	11%	18%	20%	11%	11%	7%

Source: GIS Inventory. Minor differences in total acres of MA 1.13 between alternatives are attributable to small differences in the GIS mapping and are not significant. All ROS numbers are based on the summer use season.

Illegal use of ATVs (all terrain vehicles) and snowmobiles in designated wilderness is a management concern. Where there are no natural barriers, from trees or terrain, monitoring for unauthorized use is especially important. Monitoring and law enforcement are continuing efforts.

Effect from Management Areas: Adjacent management activities can have a direct effect on the Cloud Peak Wilderness. Although the law forbids buffering wilderness, management along the boundaries can affect both management and use of the area inside the boundary. Areas with nonmotorized use are usually compatible with wilderness.

Table 3-165. Miles of common boundary between management area groups and the Cloud Peak Wilderness.

	Alt. A	Alt. B	Alt. C	Alt. D-DEIS	Alt. D-FEIS	Alt. E
Nonmotorized management areas (M.A. 1.2, 1.31, 1.5*, 2.2*)		9.5	9.9	9.5	5.2	
Limited development and motorized use (M.A. 1.32, 1.33, 3.31, 3.4, 3.5)	83.2	95.9	119.0	64.0	92.3	34.2
Motorized recreation and commodity use (M.A. 4.3, 5.11, 5.12, 5.13, 5.4, 5.5)	49.1	28.7	5.2	60.6	36.6	99.8

*Limited winter motorized use may occur)

Source: GIS Inventory

Non-wilderness uses adjacent to wilderness can have a negative affect on the quality of wilderness recreation experiences. Where roads and motorized activities occur along the wilderness boundary, the incidence of illegal use of motorized and mechanized vehicles in the wilderness may increase. High standard roads close to the boundary provide easy recreation access to wilderness and tend to increase day use. As use numbers increase, particularly day use, concentrated use affects physical, biological, and social conditions in the wilderness.

Illegal use of ATVs (all terrain vehicles and snowmobiles in designated wilderness is a management concern. Where there are no natural barriers, from trees or terrain, monitoring for unauthorized use is especially important. Monitoring and law enforcement, including aerial surveillance, are continuing efforts

Management areas bordering the wilderness and providing motorized use are more likely to affect wilderness condition and uses. The most highly developed areas (for commodity

production or recreation use) are generally those areas in Category 4 and 5 management areas. If new development occurs adjacent to the Cloud Peak Wilderness, impacts could include noise, modified landscapes, and motorized trespass. In terms of negative effects from adjacent land uses, Alternative E could have the greatest impact on existing wilderness, followed by Alternatives D-DEIS, A, D-FEIS, B, and C.

Effects from Aquatic Resources (Fisheries) Management: About 10% of the more than 300 small lakes inside the wilderness are stocked by the Wyoming Department of Game and Fish. In some cases, the fish species are not locally native. Stocked lakes attract visitors, which can result in overuse and loss of campsite vegetation, particularly in areas managed for pristine conditions. Recommending areas for wilderness designation is not expected to affect existing campsite conditions near stocked lakes. The areas recommended for wilderness in Alternative C do not have lake fisheries. The Rock Creek area recommended for wilderness in Alternative D-FEIS includes Gem Lake. Gem Lake is a shallow lake that winter kills and is not stocked. The high-altitude stocked lakes offer a particular recreation experience. Lower elevation stream fishing experiences are unlikely to divert many users.

Effects from Invasive Species: Invasive species may include non-native plants, pathogens, insects, birds, mammals, and fish. Invasive species can threaten the integrity of wilderness ecosystems. While introduced fish species are the most ubiquitous, non-native plants found in the wilderness, including ox-eye daisy and Canada thistle, have a potential to disrupt native ecosystems.

Visitor's vehicles and livestock from outside wilderness are most likely to introduce non-native, invasive plants. Certified weed-free forage products are required if used for feed, bedding, mulch or any other purpose. The Forest currently monitors for the presence of non-native plant species and uses mechanical controls (ex. hand-pulling, hand tools) where effective and feasible. Chemical controls are approved if necessary. Non-native, invasive plant control is a joint effort between the forest and the county weed and pest control.

The effects from invasive species do not vary by alternative.

Effects from Fire and Fuels Management: The high elevation environment of the Cloud Peak Wilderness is believed to be within the historic range of variability for natural fire occurrence. Historic fire suppression may have moved areas recommended for wilderness designation in Alternative C and D-FEIS outside the historic range of variability. Guidelines allow for the use of wildland and prescribed fire in these 1.2 management areas. Fire cannot be successfully returned to these areas without approved fire management plans that allow wildland fire use and burns under appropriate conditions. Use of fire must consider opportunities to minimize threats to property and life outside wilderness and 1.2 management areas, as well as protection of wilderness values.

Within designated wilderness, restrictions on use of mechanized equipment and access limitations may make fire suppression more difficult and increase suppression costs. This effect is off-set by reduced costs associated with wildland fire use instead of expending funds for suppression and by the resource benefits derived from the fire on the landscape.

Fire management does not vary by alternative.

Effects from Livestock Grazing: Commercial livestock grazing is permitted in wilderness, where it was established prior to wilderness designation in accordance with Congressional grazing guidelines. Livestock can impact streambanks and lakeshores, including altering soil and vegetation and increasing stream sedimentation; however, these effects are not wilderness-specific. For additional discussion of livestock grazing impacts on aquatic resources, see the Aquatic Resources section in this chapter.

Recreational pack stock grazing activities are not necessarily regulated by a permitting process; only pack stock used by commercial outfitters and guides is under permit. Guidelines and monitoring included in the forest plan revision provide a framework for monitoring effects of recreational livestock grazing impacts and determining the appropriate management response. Commercial livestock grazing and pack stock management also relies on monitoring to provide for protection of wilderness values.

Effects from Minerals Management: The Cloud Peak Wilderness has been withdrawn from mineral entry and is not available for new leases or claims. Surface and mineral estates within the wilderness are entirely federal. There are no private lands or private land interests. The roadless section of FEIS Chapter 3 and Appendix C cover the potential for leases and claims as well as private interests for the areas recommended for wilderness designation in Alternative C and D-FEIS. Minerals management has no effect on the Cloud Peak Wilderness.

Cumulative Effects

The cumulative effects table at the beginning of this chapter includes the list of past, present and reasonably foreseeable future activities that were considered with regard to cumulative effects to the wilderness resource. Cumulative effects have been considered for the life of the plan. The area of consideration is the Bighorn National Forest and the surrounding region: northern Wyoming, southeast Montana and the Black Hills.

Wilderness management in accordance with the standards and guidelines in the Revised Plan is designed to maintain or improve wilderness character in the Cloud Peak Wilderness. Current monitoring indicates that impacts of concentrated recreation use exceed guidelines in some areas and management actions may be needed to improve conditions. Management options include restoration activities, visitor information and education, limits on use, recommendation of additional areas or some combination of options.

The coalbed methane development in the Powder River Basin had generated several public proposals for power plant development. Development of a large point-source could have an impact on the air and water quality in the Cloud Peak Wilderness, although the prevailing winds are typically west to east. The effect of a new power plant on the wilderness would be the same under each alternative.

Population growth and development increases the need for public open space. Increasing urbanization in Sheridan and Johnson Counties, as well as population growth in Gillette,

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Billings, and Casper is likely to increase recreation use of the forest including an increase in wilderness use. To the extent that increasing acres of wilderness allows for increased use without increasing impacts, Alternatives C and D-FEIS could help meet future wilderness demand. The effects of urbanization and population growth on wilderness use and resource conditions is likely to be gradual and extend well beyond the planning period.

Our relationship to wilderness and wild lands is changing in response to societal changes including technological advances, environmental attitudes, knowledge of natural processes and disturbance factors and the diversification of the economy. Balancing environmental protection with the maintenance of existing lifestyles is a continuing public debate.

Awareness of natural disturbances (fire, insects, and disease, wind) is heightened where they threaten homes or economies based on timber or tourism. These issues will influence the public's knowledge and understanding of wilderness in the future.

Utilization of Natural Resources

Livestock Grazing

Introduction

Stockmen have been using the grasslands of this continent since the first Spanish settlers arrived in the early 1500s (Thomas 1994). Grazing by domestic livestock has occurred on rangelands of the Bighorn National Forest since the late 1800s. The industry has been an integral part of community economies, development, and lifestyles. For the livestock producer today, summer forage on the Bighorn National Forest often represents a vital part of their total program. Term grazing permits for livestock grazing, normally issued for 10-year periods, are in effect on allotments throughout much of the Bighorn National Forest. Permit holders pay a grazing fee for use of forage each year and are required to abide by terms and conditions of their permit which address livestock and land ownership, range improvements, resource concerns, management practices and requirements, etc. Most permitted livestock spend about three months out of the year on the Forest, less time if allotments are at higher elevations. Implementation of required management practices and the long-term effects of livestock use on the environment are monitored, and adjustments are made, as needed, to assure compliance with permits and to address other resource concerns.

Legal and Administrative Framework

The Bighorn National Forest Land and Resource Management Plan (LRMP), September 1985.

FSM2200 – this manual summarized laws and regulations governing rangeland management and forest planning.

FSM2600 – this manual summarizes laws and regulations governing fish and wildlife management and forest planning.

R-2 Rangeland Analysis and Management Training Guide

FSH 2209.13 – Grazing Permit Administration Handbook

FSH 2609.13 – Wildlife and Fisheries Program Management Handbook

Code of Federal Regulations (CFR) 36

- ♦ 219 Planning
- ♦ 222 Range Management
- ♦ 241 Fish and Wildlife

National Forest Management Act (NFMA) of 1976 – this act identifies information requirements concerning NFS grazing and browsing resources.

Section 8 of the Public Rangelands Improvement Act (PRIA) of 1978 – this section allows for consultation and cooperation in the development and execution of allotment management plans for grazing permits.

Federal Crop Insurance Reform and Department of Agriculture

Reorganization Act of 1994 amended the 1987 Agricultural Credit Act to provide for mediation of grazing permit cancellation and suspension actions as a part of the existing administrative appeals process.

Section 504 of the Rescissions Act of 1995, Public Law 104-19, directs the Forest to complete site-specific National Environmental Policy Act Analysis and decisions on allotments on a scheduled basis.

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Management Direction

The 1985 Plan provides management guidance regarding livestock grazing at the broad, programmatic, forestwide scale. It includes goals, objectives, management area direction, and standards and guidelines. Site-specific direction is addressed in environmental assessments and decisions that are focused on individual allotments or groups of allotments. This direction is then implemented through Allotment Management Plans (AMPs) specific to each allotment. Desired rangeland vegetation conditions are described in the Forest Plan and are made more specific for individual allotments through the project level decision. Allowable forage utilization level, along with other standards and guidelines, are stipulated on a site-specific basis. When livestock graze to allowable utilization levels or otherwise meet required standards, livestock are to be moved from the pasture or grazing area by permit holders, or removed from the allotment for the season. The Forest Service *Region 2 Rangeland Analysis and Management Guide* provides information on documenting rangeland monitoring, inventory, analysis, and management activities.

Historic and Current Grazing Use

The lands within the Bighorn National Forest and the surrounding watersheds have been grazed by wild ungulates for thousands of years (Knight 1994). As a result, the native plants and plant communities have evolved to tolerate some level of intensity, timing, frequency, and duration of grazing and browsing. Livestock grazing probably began with the Americans Indians. Eventually, Euro-American settlers brought livestock with them as they settled in the valleys and plains surrounding the Big Horn Mountains (Knight 1994). By the late 1800s, large herds of livestock were brought into and through the Big Horn Mountains (Meyer and Knight 2001). From this time on into the early 1900s, heavy and improperly managed livestock grazing

became the norm. At times, significant numbers of cattle and horses moved off of the Crow Reservation in Montana and onto the Forest (Meyer and Knight 2001).

At their peak, livestock numbers on the Bighorn National Forest were extremely high (Meyer and Knight 2001). Severe damage was experienced and documented in many of the more accessible areas (Walcott 1899, Meyer and Knight 2001). Often these impacts took the form of changes in plant species composition, accelerated erosion, downcutting of streams, lowered water tables, and declines in production. These impacts were compounded by removal of beaver and extended drought cycles that hit much of the western U.S. during this period.

Resource impacts resulting from livestock use in late 1800s and early 1900s were evident, and were documented by Professor John G. Jack. In 1900, he observed that, east of the Bighorn divide, the southern portion was very fully stocked with sheep but very few bands were grazed north of the Middle Fork of Clear Creek (Jack 1900). He found the whole area (Big Horn Mountains) south of the 13th Standard Parallel was badly overgrazed (Murray 1980), and recommended that the number of sheep on the Reserve be restricted.

With the advent of the Forest Service and the establishment of the Bighorn Reserve in 1897, improved livestock management slowly came to the Big Horn Mountains. A permit system was set in place, numbers were reduced, permit holders were assigned to specific grazing areas (i.e., "allotments"), and some limited fencing and water development was begun. At first, control was very limited and livestock numbers may have actually increased to over 30,000 cattle and 374,734 sheep by 1904. Grazing seasons remained quite long, limited primarily by snow (Meyer and Knight 2001). Actual use was probably even greater as trespass was a significant problem.

Over time, improvements in management have focused on bringing permitted numbers and seasons in line with grazing capacity, development of improvements such as fencing and water sources to better control livestock, and implementation of the latest science. Major reductions in both numbers and seasons were instrumental in initiating the recovery process for damaged resources. Permitted livestock grazing has continued to decline during the past 4 to 5 decades, due significantly to reductions in sheep grazing, primarily associated with operator economics. More recently, implementation of forest plan standards focused on meeting desired conditions and has resulted in reductions in authorized and actual use (Regan et al. 2003).

The following table shows approximate information regarding livestock numbers. Numbers in the table represent rough estimates, and should be used to define trends rather than to indicate exact stocking rates. It should be noted that in the early years of grazing permit administration, trespass could have added greatly to the estimated numbers. In addition, it took many years for the actual grazing seasons to get shortened from the situation where the livestock ran from snowmelt to snowfall, to where they are today at 2.5 to 3.5 months on average. Changes in permitted numbers cannot tell the entire story as the change in season was equally, or perhaps more, important in terms of livestock influences on aquatic, riparian, and wetland resources. In interpreting the table below, note that in terms of forage use, one mature cow is generally considered to be equivalent to five sheep (Regan et al. 2003).

CHAPTER 3
AFFECTED ENVIRONMENT & ENVIRONMENTAL CONSEQUENCES

Table 3-166. Approximation of livestock trends.

Year	Cattle (head)	Sheep (head)
1870s	Minor	Minor
1898	3,000	450,000
1904	30,000	374,734
1912	34,000	105,000
1916	36,000	108,000
1918	43,000	113,000
1919	48,500	117,000
1924	29,000	94,000
1931	32,352 (Season reduced to 3.5 mo.)	126,765 (Season reduced to 2.5 mo.)
1980s	33,000	58,000
1985	33,000	58,000
2001	29,229	21,187

Source: Data from Meyer and Knight 2001 and various other U.S. Forest Service sources).

Trends in livestock numbers on the Forest, surrounding counties, and statewide are included in the following table. Bighorn National Forest livestock numbers are those “permitted, that is those animals permitted under a term, private land, or free-use grazing permit. An AUM is defined as the amount of forage required to sustain a 1,000-pound animal for one month, or 780 pounds of forage (air-dry weight). For purposes of displaying data, an animal unit factor of 1.32 is used to describe a permitted mature cow with calf, a factor of .7 is used to describe permitted yearling cattle, and a factor of 0.30 is used for a ewe with a lamb.

Table 3-167. Trends in livestock numbers on the Bighorn National Forest.

	Livestock Numbers		
	1956	1981/85 data	2002 data
Cattle number estimates	28,450	33,000	28,025
Sheep number estimates	119,335	58,000	13,830
Total of sheep + cattle AUMs	226,839 AUMs	143,000 AUMs	118,396 AUMs

1956 estimates are made based upon “Range Survey in Wyoming’s Bighorn Mountains”, page 23, Wyoming Agricultural Experiment Station Bulletin 341, April 1956, A.A. Bettie.

1981-1985 AUMs were taken from the Bighorn National Forest Land and Resource management Plan, September 1985, PAGE II-48

2002 data was summarized from USFS data, manually, in April, 2002

Table 3-168. Trends in livestock numbers statewide.

	Livestock Numbers										
	1960	1965	1970	1975	1980	1985	1990	1995	2000	2001	2002
Historic cattle Estimates(1000 head) NASS	585	688	732	819	632	630	660	780	830	850	820
Historic sheep Estimates (1,000 head) NASS	2,248	1,989	1,713	1,226	960	740	705	538	460	420	NA

Wyoming Agricultural Statistics Service, Historical cattle estimates: Wyoming, January 1 inventory, annual calf crop, all cows

Wyoming Agricultural Statistics Service, Historical sheep and wool estimates: Wyoming, January 1 inventory, annual lamb and wool crops, breeding sheep and lambs

The above data and discussion describe a decrease in total livestock numbers and AUMs on the Bighorn National Forest since the early 1900s. Sheep numbers statewide and on the Bighorn National Forest have declined consistently since the later half of the century, while cattle numbers fluctuated. In 2002, the Bighorn National Forest maintained term grazing permits for summer grazing of 28,025 cattle and 13,830 sheep.

Relative to the **four counties** surrounding the Bighorn National Forest, permitted use in year 2002 represents *in numbers* 12% of the 233,000 cattle and 20% of the 68,000 sheep for year 2002. Relative to **state**, this represents *in numbers* 3% of the 850,000 cattle for year 2002, and 3% of the 420,000 sheep for year 2001. This permitted *number* of livestock would represent a far lower percentage of *AUMs*, since livestock spend only about 3 months on the Forest each year. Recent estimates indicate that in year 2002 the Bighorn National Forest permitted in head months (HMs) roughly 3.5% of the cattle and 6% of the sheep relative to the **four counties** surrounding the Bighorn National Forest.

Table 3-169. Trends in livestock numbers in counties surrounding the Bighorn National Forest.

	Livestock Numbers, 2002	
	Sheep**	Cattle*
Big Horn	10,000	53,000
Johnson	44,000	58,000
Sheridan	6,000	90,000
Washakie	8,000	32,000
Total	68,000	233,000

**Wyoming Agricultural Statistics Service, breeding sheep on Wyoming farms and ranches, by county, January 1, 1995-2002

*Wyoming Agricultural Statistics Service, all cattle and calves on Wyoming farms and ranches, by county, January 1, 1995-2002

Rationale for the Decline in Livestock Numbers and AUMs

The decline in actual and permitted AUMs from the late 1800s to 2002 is a result of some combination of a reduction in length of permitted season, a reduction in permitted numbers, and to a lesser extent to a matter of interpretation of data. It has to do with changes that have occurred in forage availability, the economics of the livestock industry, changes in knowledge and understanding of rangeland and riparian ecosystems, and changes in social priorities for public land management.

Forage Availability

Forage available for livestock on the Bighorn National Forest is subject to some change over time as a result of many variables, including:

- ◆ Forage being made available due to fire.
- ◆ Forage being made available due to timber harvest activity.
- ◆ Forage rendered unavailable due to shrub or timber encroachment, or regeneration.
- ◆ Increases or reductions in availability due to changes in range condition or ecological seral stage (successional stage).
- ◆ Forage rendered unavailable due to changes in land use such as campgrounds, fenced rights of way, dispersed camping, water impoundments, road construction, or other priorities for National Forest land use.
- ◆ Forage being made available through application of new grazing strategies and technologies.

Economics of the Livestock Industry

The sheep industry has experienced a decline throughout the country and on National Forest lands that has resulted in the decrease in numbers. This is likely a result of at least some of the following factors:

- ◆ Low lamb prices and high production cost faced by the sheep and wool industries.
- ◆ Increasing effects of international markets.
- ◆ A reduced ability to control expanding predator numbers and resultant herd losses.
- ◆ A reduced source of individuals able and willing to work as herders.
- ◆ Requirements to meet other resource needs on National Forest System lands.

On the Bighorn National Forest, sheep allotments have often been converted to cattle allotments at the request of permit holders who chose to no longer run sheep in these areas. Many high-elevation sheep allotments are remote, difficult to access, short in production, highly fragile, unfenced, and have been found to be unsuitable for cattle. In some cases, all or portions of these allotments have been consolidated with neighboring sheep allotments to improve the viability of remaining operations. However, in other cases, grazing permits associated with these difficult to manage allotments have been waived back to the Forest Service and allotments either closed or left vacant. Because sheep producers consider some of these areas undesirable, they have not been restocked when existing producers have discontinued their use.

The decline in permitted use by sheep and cattle is in part a result of not stocking small or remote areas of existing allotments that are not well suited for grazing, and may never have been. Often in these areas, the benefits to producers of utilizing forage no longer justify the cost of managing livestock to harvest the forage. Producers who choose to take advantage of better marketing opportunities may prompt a change in off-dates.

Changes in Social Priorities for Public Land Management

As the Bighorn National Forest receives more use by the public, more opportunities for conflicts arise, and costs incurred by producers to administer grazing permits increase. Livestock operators may choose not to stock areas where demands by other users are high.

Management has used reductions in livestock numbers and season of use as a tool to restore degraded rangeland and riparian areas. In cases where permitted AUMs are returned to the Forest, reallocation of those AUMs occurs through the grants process (FSH 2209.13), only when the range resource forestwide can support that use. Often, available capacity is used to resolve stocking or resource conflicts elsewhere on the Forest.

Interpretation of Data

Some degree of caution is prudent in comparing livestock numbers and AUM data from different sources and timeframes (Hinnant 1994, Perrier 1996). For many years, into the late 1970s, an animal unit equivalent for a cow calf pair was considered to be 1.0; today a factor of 1.32 is used for a cow/calf pair. The end result is the appearance of significant difference in AUMs under permit when in fact nothing may have changed. In some display of data and interpretation, animal unit months were not considered, but animal months (AM) or cow months (CM) were calculated and used and may have been called AUMs. For purposes of Forest Service billing, animal months (AM) are used rather than AUMs, which can lead to confusion.

The relative size of most cows and many calves is very likely larger than those historically permitted. Producers often manage so that cows bear calves earlier in the season today than in years past, and many take advantage of genetic characteristics of different breeds of cattle. Forty years ago, a cow may have averaged 900 pounds, while one today may average 1,250 pounds, and she and her large calf may consume a far greater volume of forage, resulting in fewer numbers supported by a given area. In this case, fewer animals would consume the same amount of forage (AUMs), while data would show that a reduced number of AUMs is being permitted.

Livestock Management

There are currently 86 grazing allotments on the Bighorn National Forest. Portions of the Bighorn National Forest and the surrounding watersheds are stocked by livestock at rates that are considered to be relatively high (USFS data for Rocky Mountain Region). Management has intensified over the past few decades on the Bighorn National Forest, although not uniformly across the landscape. Thus, some allotments are well and intensively managed and others continue to need improvement. There are a few remaining active sheep allotments, but much of the area suited to sheep grazing has been vacated and the allotments closed. Most of these vacant (e.g., there is no permit currently in effect but the allotment remains available for grazing

upon appropriate decision) and closed allotments (the allotment is no longer available for permitting of livestock use) came into that status for economic reasons when the livestock operators determined that it simply was not economically feasible to continue to operate on those lands and waived (relinquished) their permits back to the Forest Service. Today, most of the Bighorn National Forest permitted use is by cattle.

Livestock grazing (and in some instances, grazing by large wild ungulates) tends to have the greatest influence on the following:

- ◆ Low-gradient riparian and wetland areas.
- ◆ Fine textured soils with a minimal amount of rock, cobble, or boulders.
- ◆ Open canopy or low shrub vegetation types.
- ◆ Areas with available water (although there may be some avoidance of standing water areas).

The magnitude of the influence depends on the timing of use, the kind of livestock (sheep vs. cattle), the intensity of grazing use, the duration and frequency of grazing, and the associated management practices, including the level of permittee interest and involvement.

Most allotments are managed through a rotation grazing system, designed specifically for the allotment. Management calls for sheep to be herded and moved to new bed-grounds each night. Most cattle allotments are managed under some kind of pasture rotation system that will use most or all of the pastures each year but will generally avoid the use of an individual pasture at the same time in succeeding years. A few cattle allotments are grazed under a season-long system where livestock distribution is controlled with water, salt, and herding. Salt is located to help draw livestock away from riparian areas, and most permit holders regularly move livestock out of riparian areas and into other areas of available forage.

Site-specific NEPA analysis is completed during the allotment management planning process. The Bighorn National Forest is on a 15-year schedule to update and revise allotment management plans as mandated by the 1995 Rescissions Act. To date (August 2005), 46 of the 86 allotments underwent updated rangeland analysis followed by project level NEPA decisions with resultant updates and revisions of the allotment management plans. Project level allotment NEPA decisions are developed using the goals and objectives as well as the standards and guidelines of the approved forest plan. More specific grazing prescriptions can be developed during the allotment management planning process to address site-specific issues.

Permitted livestock grazing levels are often based on historic actual and permitted use levels. Allotment management plans establish site-specific goals and objectives, and management strategies to achieve them. Management strategies may include levels of grazing use, seasons of use, rotations, and a schedule for implementing range improvement projects such as fences and water developments.

Permitted use by cattle and sheep is nearly always authorized through term grazing permits, normally issued for 10 years. These permits include numerous terms and conditions that describe responsibilities of the permit holder such as validation, payment of grazing fees, ownership requirements of livestock and base property, livestock management, range

improvement maintenance and construction, and more. Allotment management plans become part of the permit. General consequences of permit non-compliance are described in the permit.

When instances of non-compliance occur, discussion about the issue normally results in resolution. Successive instances of non-compliance that continue can graduate to suspension or cancellation of all or part of permitted numbers. These cases are relatively rare and are considered a last resort by management to gain compliance. In some cases, repeated instances of improper use of rangelands or other undesirable resource impacts can indicate a need to change grazing strategies or to adjust livestock numbers or length of season (AUMs).

Forest Plan Monitoring

A review of forest plan monitoring reports (see following table) indicates that between 1995 and 2002, a range of 42 to 73% of the allotments on the Forest were monitored annually by the Forest Service, through spot-checks of forage utilization or stubble height transects. Of allotments monitored through those years, 38 to 88% of transects met standards specified. This indicates a wide degree of variance in compliance with prescribed utilization standards. Where pastures have not met standards, corrective actions have been implemented as directed and described in term grazing permits, FSM 2200, FSM 2209.13, and the Bighorn National Forest Vegetation Grazing Guidelines (April 9, 1997).

Table 3-170. Results of allotment monitoring on the Bighorn National Forest from 1995 to 2002.

	Percent of Allotments Monitored by Forest Service	Percent of Forage Utilization Transects that Met Standards	Allotments Exceeding Standards to the Point of Discussing/Implementing Resource Recovery Period
1995	73%	69%	4%
1996	70%	52%	14%
1997	59%	76%	3%
1998	42%	88%	1%
1999	63%	71%	6%
2000	48%	38%	16%
2001	61%	52%	18%
2002	50%	58%	15%

Source: 2003 Forest Plan Monitoring Report, Summary for Range.

According to an April 26, 2002 summary table, the Forest permitted 118,396 AUMs (shown on the face of a term grazing permit). In year 2003, according to the INFRA database, the Forest authorized 84,100 AUMs (Bills for Collection were sent and paid).

Permittees have various reasons for requesting and running fewer AUMs than permitted: 1) for personal reasons they don't have stock to fill the permit; 2) they expect below average production of forage due to drought this year or in previous years; 3) they expect lower than average production because of overgrazing the previous year or years; 4) they want to 'not' use an area to allow fine fuels to build up for prescribed burning; 5) they recognize that the permitted numbers and/or time has never been set at a realistic level and can be grazed only in

the very best of production years; 6) they choose to turn livestock onto the Forest later than their permitted date or come off earlier than permitted, for an array of management reasons.

The number of actual AUMs grazed is often less than that authorized because of the above reasons, but also possibly because in some cases allowable use standards are reached and livestock must be removed from the Forest before permitted days are used, in order to prevent overgrazing or other resource problems.

The 1985 Forest Plan includes an objective of providing an annual output of 140,000 AUMs in 1991-2000, and 144,000 AUMs in 2001-2010. Data and discussion above indicate that this objective has not been met, and is probably unrealistic. In an informal review of stocking levels in Region 2, average stocking rate in acres per AUM averages 6.22 on acres with range management objectives. The Bighorn National Forest average stocking rate across all allotments is 2.5 acres per AUM.

The 1985 Forest Plan includes four primary goals for the “range” resource. Two involve rangeland health and are addressed in the Rangeland Vegetation section of this document. The remaining two are:

- ◆ Provide livestock grazing that satisfies requirements for local community stability.
- ◆ Use grazing systems and stocking rates that reduce conflicts between domestic livestock, recreation, and wildlife.

The above discussion and data shows the level to which the Forest has provided livestock grazing. Monitoring does not indicate whether this level has or can “satisfy requirements for local community stability.” In addition, while managers recognize that conflicts continue between livestock, recreation, and wildlife, monitoring also does not indicate whether conflicts have been “reduced.”

Recreational horse use on the Forest rangelands includes frequent use by local enthusiasts as well as occasional trips by individuals and organized groups from across the country. Uses vary from small parties of day and weekend riders and packers to larger groups (e.g., Backcountry Horsemen and Bighorn Trail Rides), who take annual trips. Hundreds of resident and non-resident visitors and hunters visit the Forest each summer for day and pack trips, as well as in fall during mule deer and elk hunting seasons.

Grazing by recreation horses often occurs on cattle and sheep allotments and can result in forage use and impacts to streams and vegetation that often conflict with objectives and plans of term grazing holders. These effects may be localized, can be significant, and are often less well documented and monitored. Management of recreation horse use is often unregulated, with the exception of those permitted under special use permit.

Livestock Grazing Permittee Operations and off-Forest Open Space: Ranchers who hold National Forest grazing permits are required to own private lands (base property). They often also hold BLM permits and state land leases. Land management is intermingled and interrelated; a management change on any one may affect all. They often own many more acres of rangelands than they use on the Forest. These acres frequently provide big game winter range and other important wildlife habitat needs. They provide “open space” on the landscape that benefits the community and the state.

There has been an increasing tendency in recent years for some ranchers to sell off a portion of their deeded lands in an attempt to keep the remainder as a viable unit, and to keep it in historic family ownership (Mitchell 2002). Subdivision of ranches can lead to an increase in free-ranging dog and cat populations, with a resultant increased predation on small mammals and songbirds, and even some larger mammals such as deer fawns. It can result in more vehicular traffic, illumination from yard lights (light pollution), invasion and spread of non-native plants, more human presence, each of which creates disturbance zones around houses and roads that can diminish wildlife populations (Mitchell 2002).

As ranchers sell portions of their base ranches, winter range for wildlife can become fragmented and may be lost. The net effect is a loss of the habitat needed to maintain viable populations of native wildlife. As ranches turn into ranchettes and rural subdivisions develop across the West, many native species are declining and being replaced by species adapted to human habitation: lark buntings and bobcats by starlings and skunks, rattlesnakes and warblers by garter snakes and robins. It has been said that most Americans want to conserve native species and our western wildlife; keeping private ranchlands in ranch family hands and out of developers' plans is the single greatest environmental contribution to achieve that (Rey 2002).

ENVIRONMENTAL CONSEQUENCES

General Effects

Standards and guidelines in Alternatives A through E are identical. Changes from those in the 1985 Plan are primarily for clarification and update, and in most cases reflect changes that have already been implemented administratively. There are some differences in standards and guidelines between revised management prescriptions. The mix of these prescriptions is different between alternatives, and this difference in the mix is the main reason for any difference in effects between alternatives. On a forestwide basis, differences are usually small, often subtle, and difficult to quantify.

Permitted livestock AUMs on the Bighorn National Forest have decreased since the early 1900s, and data indicates that they continued to decline into year 2002 (see Table 3-167) (Regan et al. 2003, Meyer and Knight 2001). There are more demands for various uses of the Forest. Some rationale for the decline in livestock numbers and AUMs still applies; for example, the total acres of suitable rangeland in active allotments have incrementally decreased through the years, and this trend may continue (See discussion above). At the same time, widespread areas of overgrazing described in the early 1900s are no longer reported to occur (see Rangeland Vegetation discussion in the Vegetation section). Range management practices are better now than at the turn of the century and rangeland condition is probably better than at that time (Meyer et al. 2003, Powell et al. 2001).

The ability of today's permittee to maintain permitted AUMs is dependent to a large extent upon the economics of managing livestock in a rangeland setting that includes public lands. In addition, competition for limited National Forest resources and the permittee's ability to

manage livestock to meet standards and guidelines, goals, and management area direction all affect the viability of livestock operations.

Actual and permitted grazing levels are not an objective or goal of the Revised Plan but rather a product of management recognizing that livestock grazing is an appropriate use of the Bighorn National Forest while applying management to meet standards, guidelines, and management area direction. Permittee involvement and commitment are critical to sustaining current AUMs under term permit. At today's stocking levels, across all alternatives, many permittees will succeed in managing livestock within these parameters. It is possible that some permittees may be able to manage in a manner that would allow for an increase in AUMs on their allotment. However, some permittees likely will be unable to manage their livestock operations to meet standards and objectives and will face reductions in permitted numbers (and AUMs under permit) or significant changes in their management operations. In some cases where actual stocking has rarely approached permitted AUMs, permits may be adjusted to reflect a more realistic permitted AUM level.

A review of stocking levels on Bighorn National Forest Allotments (Regan et al. 2003) indicates that some allotments are stocked much more heavily than others. Forest plan monitoring indicates that there continue to be areas where utilization standards are not being met. It is entirely possible that as project-specific NEPA decisions are developed and applied, and where these factors and other issues occur and overlap, a decrease in AUMs permitted may result. Subsequently, total AUMs permitted on the Bighorn National Forest is likely to continue to decline until a sustainable stocking level is achieved on all allotments.

Direct and Indirect Effects

Effects from Wilderness Management (Management Areas 1.11 Pristine Wilderness, 1.13 Semi-Primitive Wilderness, 1.2 Recommended Wilderness): These areas are to be managed to protect their wilderness characteristics. Management activities are intended to maintain a naturally functioning ecosystem. Livestock grazing "and activities and the necessary facilities to support a livestock grazing program, will be permitted to continue in National Forest wilderness areas, when such grazing was established prior to classification of an area as wilderness" in accordance with Congressional Grazing Guidelines (WO Amendment 2300-90-2, FSM 2323.2, pp. 19-26). There is to be "no curtailment of grazing permits or privileges in an area simply because it is designated wilderness." "Wilderness designation should not prevent the maintenance of existing fences or other livestock improvements, nor the construction and maintenance of new fences or improvements which are consistent with allotment management plans and/or which are necessary for the protection of the range."

Management of permitted livestock in these areas can be made more difficult and costly than in other areas of the Forest due to 1) restricted motorized travel for access, 2) restricted use of motorized equipment such as chainsaws, and 3) restrictions on other management activities such as design of new range improvements. The restriction of travel for access, however, can also be viewed as a benefit (see travel management, below). Since areas without motorized use contain a lesser diversity of uses (i.e., only nonmotorized recreation, versus motorized and nonmotorized recreation present in other areas), fewer conflicts between users with different expectations of their recreation experience are likely to occur.

Indirect effects from wilderness management include 1) an increased expectation of no livestock presence by forest visitors and associated complaints, 2) a need to manage around a recreational “wilderness” experience to minimize conflicts, with a potential increase in people and horse use (and associated conflicts) over levels prior to this designation, 3) a need to manage for wilderness character and plant communities, and 4) a potential loss of opportunity for issuance of off-road travel permits for administration of grazing permits.

Alternatives are identical in allocation of Management Areas 1.11, 1.13. There is some variance among alternatives with regard to Management Area 1.2. Alternative C and D-FEIS recommend 126,575 acres and 33,858 acres respectively, for Recommended Wilderness (MA 1.2). The areas proposed for wilderness designation were selected based upon their present condition and setting as roadless areas.

Approximately 7,884 acres of suitable rangeland (within active and vacant allotments) are within the Cloud Peak Wilderness. An additional 10,623 acres would be added under Alternative C (see table below) and 611 acres under Alternative D-FEIS, respectively.

Table 3-171. Suitable rangeland in the Cloud Peak Wilderness and recommended wilderness areas.

Suitability analysis	Acres in grazing allotments and in wilderness, current	Acres in grazing allotments in recommended wilderness, Alt C	Acres in grazing allotments in recommended wilderness Alt D-FEIS
Acres suitable lands, Cattle	7,855	15,557	8,466
Additional acres suitable lands, Sheep	29	2,950	40
Total acres	7,884	18,507	8,506

Effects from Roadless Area Management: Implementation of the Roadless Area Conservation Rule does not affect livestock grazing.

Effects from Management of Special Interest Areas, MA 2.1: Alternative B has two new archaeological special areas: Elephant’s Foot and Buck Creek Vees. Alternative C has Buck Creek Vees proposed as a new archaeological special area, but it does not have Elephant’s Foot special area proposed, because in this alternative the area is proposed wilderness. Alternative A, D-DEIS, D-FEIS, and E have no additional special area (Category 2) proposed.

Livestock management is unlikely to be different in the proposed Elephant’s Foot and Buck Creek Vees archaeological special areas as a result of the formal 2.1 designation, since federal law requires that effects be evaluated and mitigated forestwide (National Historic Preservation Act). For this reason, effects of this designation are identical across all alternatives. However, heritage sites are more likely to occur in these areas than outside of these areas. Effects from heritage management are described below.

Effects from Heritage Management: Cattle and sheep can contribute to the deterioration of heritage resources through physical contact (e.g., hoof action, rubbing on structures) or by contributing organic matter to a site. They can remove or alter vegetation that serves to protect sites from erosion and can make heritage resources more visible for unauthorized collection. In

cases where the level of impact is determined to be unacceptable, the impacts can be mitigated with fencing, which can be costly or with changes in management (intensity or timing). If livestock are excluded from a site or forage use levels are reduced, total available forage (AUMs) on an allotment is reduced.

Federal law requires that effects of livestock grazing be evaluated and mitigated forestwide. This takes place during development of the allotment management plans. Effects of heritage management are identical across all alternatives.

Effects from Management of Research Natural Areas, MA 2.2: RNAs are managed to maintain relatively pristine or pre-settlement conditions by allowing ecological processes to prevail with minimal human intervention. Specific management direction is to be developed addressing grazing for each Research Natural Area as part of the Establishment Record or in separate management implementation guidelines. RNA boundaries were established in concert with district range specialists to avoid inclusion of areas currently used by permitted livestock. The impact to current livestock grazing should be very minor or none.

Analysis indicates very little suitable range in any of the proposed RNAs, but the future opportunities to use that which exists could be lost with designation of new RNAs. Of the 4 new RNAs proposed, roughly 173 acres of McLain RNA has received use by permitted livestock on a regular basis as a forage reserve for several years. Although this area is part of a sheep allotment that is vacant, sheep from the adjacent allotment have been authorized to graze this area for a short period of time each summer. In addition, 518 acres of Babywagon Sheep and Goat (S&G) allotment are within the proposed boundary of this RNA. Designation of McLain Lake RNA may take away the option of authorizing this annual use of 17 AUMs on the vacant Lake McLain S&G allotment, and 52 AUMs on Babywagon S&G allotment.

Alternative B, C, and D-DEIS have identical new RNA designations: Mann Creek, Leigh Creek, Pheasant Creek, and Lake McLain. These designations may reduce the option of authorizing 69 AUMs of sheep grazing as described above, depending upon specific criteria included in the establishment record of that RNA. By comparison, Alternative D-FEIS has two new RNA designations, Mann Creek and Leigh Creek, and neither would impact current grazing use. In general, RNAs are expected to have very limited, if any, effects on livestock grazing.

Effects from Management of Special Interest Areas (Medicine Wheel), MA 3.1/MW: The Medicine Wheel National Historic Landmark (110 proclaimed acres) is located within the 3.1 Special Interest Area proposed in Alternatives A, B, C, D-DEIS, and E. In Alternative D-FEIS, the area is allocated to Management Area MW. In this area, vegetation, terrestrial and aquatic habitat, soil productivity and water quality are to appear nearly natural. Livestock grazing is to be managed in a way that will not detract from the spiritual and traditional values associated with the Medicine Wheel. Grazing has been and will continue to be excluded in the area immediately surrounding the Medicine Wheel (<1 acres).

Costs to the livestock producer in this area may be greater than in other areas of the Forest. Some restrictions in travel, structural improvement design, and livestock use will occur. Trailing of cattle, forage utilization levels, herding and other management activities may be more demanding to the producer. Alternative A and the No Action Alternative would retain the existing National Historic Landmark area as the 3.1 management area. In Alternatives B, C, D-

DEIS, and E, the area designated 3.1 is 20,863 acres, and the impact could therefore cover a much larger area. In Alternative D-FEIS, the area designated as MW is 20,863 acres.

Effects from Fire and Fuels Management: Fire and fuels management can have effects to livestock grazing, often different in the short-term than in the long-term. Effects depend upon the burning conditions and whether it was a controlled burn or a wildfire, since results of wildfire are often less predictable.

In the case of prescribed fire, livestock are generally managed so that the pasture(s) to be burned are rested in advance, to assure adequate fine fuels (residual grass) to carry a fire. Pastures are often rested following the burn to allow for vegetative recovery. This “resting” requires that the permittee be flexible in management, and involved in considerable advance planning and coordination, especially if it requires livestock to use other allotments or forage sources. If the planned prescribed fire does not take place on schedule, arrangements need to be made again in successive attempts, and can accrue additional costs.

Grazing is often deferred for up to two growing seasons following a fire to allow vegetation to reestablish. Deferment time can be decreased or increased depending upon the amount and timing of precipitation events following the burn. Recent fire effects studies (Perryman and Laycock 2000) indicate that the amount of deferment needed is dependent on the post-fire vegetation condition desired; for example, if more forbs are a component of the desired condition (for wildlife habitat needs, for example), then grazing immediately after green-up will increase the amount of forbs by reducing competition with grasses (versus two years of rest, which would reduce the forb component in the plant community).

By managing sagebrush density and structure on rangelands, prescribed burning often results in an increase in forage production (grass/forb) and availability, and a shrub community more compatible with a variety of wildlife species. It accelerates a recycling of nutrients, and can result in making water more available across the landscape, in springs, seeps, and intermittent streams. This can have the effect of simplifying livestock management, improving livestock or wildlife distribution, and increasing available AUMs.

A significant effect often results from under-burns in conifers or other types of burns that can temporarily increase forage production and accessibility. They also have the negative effects mentioned above (e.g., coordination, rest, deferment, etc.)

The more prescribed fire is used, the greater the impacts described above. The use of prescribed fire for fuels treatment and vegetative management is described in the following table.

Table 3-172. Prescribed fire acres by alternative.

	Alt B	Alt D-FEIS	Alt D-DEIS	Alt E	Alt A	Alt C
Forested Rx Burn	1,100	1,150	1,050	250	500	250
Non-Forested	3,000	2,600	2,500	2,500	2,000	1,500
Total	4,100	3,750	3,550	2,750	2,500	1,750

The use of prescribed fire for fuels treatment and vegetative management in non-forested vegetation is greatest in Alternative B, followed by Alternatives D-FEIS, D-DEIS, E, A, and C. Differences between alternatives (above) are projected, and when applied across the Forest they are not large.

A wildfire can have similar effects but is likely to have unplanned effects as well. It may result in entire pastures or allotment being burned. Livestock may have to be completely removed from an allotment or pasture (sometimes even to avoid being caught in the fire). Fences and stock pipelines may be destroyed. A permittee may be forced to alter planned grazing management of other lands in his operation (private, state, and BLM). If fences are burned, grazing systems must be modified until the fences can be replaced, which can add expense to the grazing permittee as well as the Forest Service.

Wildfire may remove sagebrush and remnant grasses and forbs; it can recycle nutrients, and may result in many of the same benefits that prescribed fire provides. Since timing, location, and burn conditions are not in the control of management; however, these benefits are less likely to be realized.

Wildfire may remove trees and open the understory of timber types to a flush of grass and forb production for many years. Similar to prescribed fire in sagebrush types, this can have the effect of recycling nutrients and providing forage for livestock. It can result in making water more available across the landscape, in springs, seeps, and intermittent streams, and simplify livestock management by improving livestock distribution, and increasing available AUMs.

Effects of wildfire are described in the Fire and Fuels section of this chapter.

Effects from Recreation Management: Recreation management can alter livestock grazing in several ways. One common effect from recreation use occurs when Forest visitors open gates along National Forest System roads and trails to pass through and then do not close them. This frequent occurrence allows livestock to drift into pastures, allotments, roadways, or other areas where they are not intended to be and often results in unplanned livestock use and disruption of planned management. Grazing permits require that stockmen keep livestock in designated areas. To comply, and to minimize the task of gathering and returning livestock, a rapid response is necessary, and can incur considerable expense. In some cases, cattleguards can replace gates, but materials, installation, and maintenance are costly.

Recreation can add expense to livestock operators who, in springtime, must repair fences that are cut or otherwise damaged by wintertime snow-goers.

Achieving reasonably uniform livestock distribution across a landscape is one objective of livestock management, since it allows an optimization of harvest of available forage resources by permitted livestock. Areas with campers, pet dogs, ATVs, and other concentrated human activity are not favored by livestock. Concentrated or frequent recreation use along roads and near popular areas can cause cattle or sheep to avoid grazing or passing through an area, and work directly against a permittee's attempts to distribute livestock evenly.

Cattle trailing along roadways can cause traffic congestion and a hazard to motorists and livestock. Cattle are sometimes shot during hunting seasons, resulting in a direct economic loss to their owners.

Summer-home owners sometimes become concerned with livestock in and around their cabin permit areas. This is also true of people using camping and picnic sites on the forest. Fences are a common solution, but require installation and maintenance that can be costly.

Fencing of scenic byways results in a safer travel way for motorists and livestock but also a loss of forage available to permitted livestock. Right-of-way fence can either disrupt planned grazing management or it can increase the management flexibility by creation of additional pastures.

Guard dogs are used by some ranchers to protect sheep. The recreating public can distract some dogs away from their sheep, resulting in a reduced effectiveness in protecting sheep and time lost to the task of locating a guard dog. The dogs can also intimidate recreationists and may contribute to conflicts between recreation and livestock grazing.

Use of the Forest for recreation is likely to continue to increase over time (see the Recreation section of this chapter). Higher levels of summer recreation create increased levels of potential conflicts with livestock use. Those alternatives that allow more areas of motorized and dispersed recreation are likely to impact livestock grazing the greatest, as discussed in more detail in the following section on travel.

Effects from Travel Management: Forest roads and trails are used by grazing permittees to conduct management operations. They are used by other Forest visitors and permit holders for a variety of purposes. The network of roads across the Forest has positive and negative effects on livestock grazing.

Livestock are trailed to and from the Forest grazing allotments along roads. Stock driveways cross the Forest and access allotments along roads. Roads are used to transport sheep and cattle to and from mountain allotments. Permit holders access cow camps and various pastures of each allotment along the Forest travel ways. Many existing roads and trails follow historically established livestock trails.

Grazing permittees may experience lowered operating costs by having motorized access to allotments on open roads. In many cases, permittees are issued limited short-term 'off-road vehicle' permits to allow them to use motorized vehicles on closed roads, or in areas where there are no roads for specific management purposes.

While roads improve efficiency of permittee activities, they also allow more public access for recreation purposes such as hunting, fishing, camping, ATV use, etc. The increase in public use of an area provides additional opportunities for conflicts between users such as gates being left open, livestock being disturbed, and cow camps or other improvements being vandalized.

In areas recommended for wilderness designation or other nonmotorized use, very little if any motorized use is currently taking place. Any formal designation to limit travel would make very little difference to current management.

Alternatives A through E restrict travel to designated roads and trails in the "C" areas on the current travel map where travel is now unrestricted. This designation may result in less disruption of livestock management activities by the recreating public than the no action alternative. Occasionally, permittees will be issued limited short-term off-road vehicle permits

to allow them to use motorized vehicles on closed roads, or in areas where there are no roads for site-specific management purposes.

The alternatives with the potential for additional summer-motorized travel (based on motorized ROS acreage), from most to least, are E, A, D-DEIS, D-FEIS, B and C. It is important to note that with the prohibition of cross-country motorized travel, actual legal motorized travel would be dependent on the presence of system routes.

Effects from Big Game Use Management: Big game grazing/browsing is generally compatible with livestock grazing/browsing. There is a large dietary overlap (40-80%) between elk and cattle (Kufeld 1973a); there is a similar, though smaller, dietary overlap between sheep and deer (Kufeld, Wallmo et al. 1973b).

Demand of big game can exceed the capability of the land and can cause detrimental impacts to vegetative and soil resources. Conflicts over the allocation of forage resources are ongoing and increasing as certain big game populations continue to expand. Forage on grazing allotments that is allocated to permitted cattle or sheep can be removed by wildlife when this occurs. In certain cases, limitations may be placed on forage use by permitted livestock in order to assure adequate forage for the wild ungulate populations.

Attempts to manage rangelands can be thwarted by heavy unplanned use by wild ungulates. Heavy browse of willows by deer, elk, and moose can restrict plant community development. Barking of aspen by moose can be detrimental to a stand, and browsing of young aspen can limit attempts at stand regeneration.

Effects from big game management are consistent across alternatives.

Effects from Mineral and Energy Development: Increased mineral development can add to road systems and increased travel; effects are described in travel, above. The potential for these activities is very small based upon past activity levels on the Bighorn National Forest. There is nothing in this analysis that indicates an increase in future levels of development.

Effects from Rangeland Vegetation Management: Rangeland vegetation management through prescribed fire is described in "Fire and Fuels Management" above, as well as the Vegetation section.

Effects from Timber Management: As timber is harvested it may open the canopy so that an increase in forage occurs in the understory, or it may create new acreages of rangeland vegetation in small harvest units. This transitory rangeland remains in this state until the forested stands once again close in or young trees become dense enough that rangeland vegetation no longer occupies the site. In this way, timber harvesting provides forage that can be made available for livestock and wildlife.

Timber harvest can also result in removal of natural barriers to livestock movement through pastures of an allotment. Construction of fences may be necessary to mitigate this loss of a natural barrier.

Permitted AUMs are not expected to increase, because transitory range is available for a limited time, until the forested cover types once again close in and eliminate under-canopy forage. The greatest amounts of transitory range would be created in Alternative E, followed by A, D-FEIS, D-DEIS, B and C.

Effects from Wildlife and Fisheries Management: The influence of large wild ungulates is described above, and effects can be expected to increase as populations increase. Other wildlife management activities may result in effects to livestock grazing such as:

- ◆ Management to increase beaver populations and activity can alter forage production and availability for livestock by expanding riparian habitat.
- ◆ Management for bighorn sheep could result in need for removal of domestic sheep.
- ◆ Management for fisheries and wildlife may involve adjusting length of time, intensity, and timing of livestock use, livestock exclusion, fencing, spring developments, etc. in cases where livestock use impacts riparian vegetation and stream habitat.

The primary methods used to improve wildlife habitat of the Bighorn National Forest include prescribed fire, fencing, and timber harvest or conifer removal. Fences constructed for fisheries and wildlife management can impede livestock movement and access, and may require specific placement or design.

Effects from wildlife and fisheries management are largely consistent across alternatives, and are budget dependent.

Effects from Threatened/Endangered/Sensitive Species Management: Habitat requirements in and around each known or discovered TES species location will be protected, restored, or enhanced. This may require changes in livestock management and are dealt with on a site-specific basis in allotment planning. Grazing strategies, locations, and forage use levels could be affected. Conservation strategies, plans for critical habitat delineations, and biological opinions generally spell out specific management requirements during allotment management plan revision.

Management of threatened, endangered, and sensitive (TES) species will have a consistent effect on livestock grazing for all alternatives.

Cumulative Effects

The cumulative effects table at the beginning of this chapter includes the list of past, present, and reasonably foreseeable future activities that were considered with regard to cumulative effects to livestock grazing. This discussion considers effects to livestock grazing since their first appearance on the Bighorn National Forest, through the next planning period (estimated at 15 years). It considers effects to the Bighorn National forest and the adjoining 4 counties.

Historic use of the Bighorn National Forest continues to be evident, and influences livestock management today. For example, some areas are continuing to recover from impacts of heavy grazing in the early 1900s. Riparian areas altered by the tie hacking activities also continue to recover. Livestock management in these areas is tailored to enhance and continue recovery. Fire suppression activities in the past have resulted in conifer encroachment in areas, which in turn can limit forage production and availability today, and effect livestock use and distribution patterns.

Livestock grazing on the Forest today is influenced by the litany of effects described above that include the allocation of forage resources between livestock and wildlife and the effects of the activities, limitations introduced by wilderness designation, adjustments necessary to protect

heritage resources, fisheries, and water quality; considerations necessary due to wildfire and prescribed fire management, recreation activities that result in gates being left open, forage being removed, livestock being poorly distributed, or impacts to the resource being unfairly attributed to livestock and managers. Most of these factors add to complexity and expense of the livestock operation that chooses to utilize forage on the Bighorn National Forest. Combined, these factors are likely to result in continued reduction in livestock grazing, though in smaller increments as compared to past decades.

Livestock management is generally considered more difficult on National Forest System lands than on private lands for reasons described above. In addition, the business of livestock management is subject to factors most often not under the control of livestock operators, such as national security (tourism), land values and subsequent subdivision of base ranches, retirement of 'baby-boomers', labor prices and availability, foreign markets and lamb/calf prices, USDA budgets and farm programs, fuel prices, predator control, social values, and federal policy.

Expectations are that the impact of recreation uses on the Forest will increase as the population of local communities increases, and as more people nationwide continue to seek places like the Bighorn to recreate. ATV use in particular has seen a dramatic increase recently that is expected to continue, although the rate of growth is not likely to be as dramatic as it has been in the past (see Specialist Report for Recreation on file in the administrative record). Locally, the current boom in coalbed methane activity has resulted in more demand for recreational use of the Bighorn, particularly for motorized uses, and this boom is expected to continue (USDI BLM 2003). Use of prescribed fire will likely increase in coming years due to past fire management policies that resulted in a great risk of intense wildfire. As described above, this can result in short-term expenses and long-term benefits to livestock grazing.

As a result effects described above, livestock grazing is expected to continue on the Bighorn National Forest, however, total permitted AUMs are likely to continue to decline until a sustainable stocking level is achieved on all allotments. Management of livestock grazing to deal with cumulative effects will be consistent across all alternatives.

Minerals and Geology

Introduction

Individuals operating under United States mining laws have a statutory right to enter National Forest lands to locate and develop mineral resources. Mineral resource activity on the Bighorn National Forest has historically been widespread but sporadic. Mineral activity is presently concentrated in a few scattered areas. Activity has fluctuated with demand, and current low prices for many minerals make exploration and development uneconomical.

The Forest Service manages mineral-related activities consistent with multiple-use management principles. The agency integrates the exploration, development, and production of mineral and energy resources with the use, conservation, and protection of other resources

Legal and Administrative Framework

The General Mining Law of 1872 allows exploration, development, and production of minerals from mining claims on public lands.

Organic Administration Act of 1897 reserved the lands for National Forest purposes and opened them to the operations of the U.S. mining laws, provided individuals/operators comply with the rules and regulations of the Secretary of Agriculture. This act authorizes the Secretary of Agriculture to regulate occupancy and use of the National Forests and protect National Forests from fire and depredations through compliance with existing rules and regulations. The act permits access to National Forests for all lawful purposes, including prospecting and locating and developing mineral resources. Regulations issued under the act authorize protection of paleontological resources from theft and destruction (36 CFR 261.9) and requirements for environmental protection during mineral operations are listed Under 36 CFR 228.8.

The Mineral Land Leasing Act of 1920 established the leasing system for the acquisition of coal, phosphate, oil, oil shale, gas, and sodium.

The 1947 Mineral Leasing Act for Acquired Lands extends the provisions of the mineral leasing laws to federally owned mineral deposits on acquired National Forest System (NFS) lands and requires the consent of the Secretary of Agriculture prior to leasing.

Mineral Material Act of 1947 authorized disposal of common variety minerals. It also allows free use by government agencies, municipalities, and non-profit organizations.

The Surface Resources Act of 1955 allows the sale of mineral materials such as sand and gravel and provides direction for multiple use of surface resources of mining claims.

Federal-Aid Highway Act of 1958 the Secretary of Transportation may appropriate, for highway construction, reconstruction, or maintenance, lands or interests in lands owned by the United States, including those under Forest Service jurisdiction (23 U.S.C. 317).

The Endangered Species Act of 1973 requires protection of habitat for endangered species.

The Federal Cave Resources Protection Act of 1988 enacted to secure, protect, and preserve cave resources, to include paleontological deposits, sediments, and minerals on Federal lands for the perpetual use, enjoyment, and benefit of all people.

The Petrified Wood Act of 1962 includes direction for the collection and disposal of petrified wood from National Forest System lands. A permit may be issued to amateur collectors and scientists to take limited quantities of petrified wood for personal use, but the material taken may not be bartered or sold. Rules for the collection of this material may vary by area depending on the quantity, quality, and accessibility of the material and the demand for it. (36 CFR 228.62(e)).

Resource Protection Measures

Locatable minerals

36 CFR 228 requires a claimant to file an operating plan or notice of intent (NOI) for proposed mining activities. The plan must include the name and address of operators, a sketch or map of the location, descriptions of operations, access timing, operating period, and environmental protection measures. The Forest coordinates with the claimant to assure that standards and guidelines outlined in the Revised Plan are met. The operating plan requires an environmental analysis and decision before it is approved.

AFFECTED ENVIRONMENT

Geology

The Big Horn Mountains are an outlying portion of the Rocky Mountains, extending approximately 80 miles from north-central Wyoming into south-central Montana. The elevations range from approximately 4,200 feet at the base of the mountains to 13,167 feet at the crest of Cloud Peak. The Big Horn Mountains begin in the north at the canyon of the Bighorn River, north of which is the Pryor Mountains. A wide basin, the Bighorn Basin, extends west of the Big Horn Mountains to the base of the Shoshone Mountains. On the east, there is the Powder River Basin that extends towards the Black Hills.

The Big Horn Mountains are divisible into three units. The northern unit extends northward from near the Montana-Wyoming border to the vicinity of the Bighorn River. This segment of the Big Horn Range is about 10-miles wide. The surface has a gentle northerly slope, with monoclinical folding of Paleozoic and Mesozoic strata with a westward dip of approximately 70° marking the western flank of the range. To the south, this

monocline becomes steeper and transitions into an eastward-dipping thrust fault. The terrain varies from steep, narrow drainage canyons, to steep-walled glacial cirque basins and windswept alpine meadows above timberline. The eastern flanks are characterized by numerous hogbacks of younger strata that dip abruptly beneath the surface along with paired anticline/syncline structures paralleling the mountain front. Sinkholes filled with younger formations and caves are common features of the Big Horn Mountains, with most caves concentrated on the abrupt faces on steeper slopes near the Forest boundary. Sinkholes are more common on the northwest portion of the Forest along ridges. These subsurface resources can be impacted by surface activities. Refer to the Biodiversity section of this chapter for additional information about caves.

The main core of the Big Horn Mountains is granite, while the northern third (basically north of Burgess Junction) and the flanks of the mountain are primarily sedimentary layers. The flanks of the mountains are composed of younger Paleozoic- and Mesozoic-age (500 to 60 million years old) sedimentary rocks that dip steeply away from the center of the mountain mass toward the adjacent basins. The chemical composition of the local geology significantly influences aquatic, riparian, and wetland conditions on the Forest.

The different sedimentary formations were created by different sea conditions. The following table provides a list of the major geologic formations on the Forest and associated Fossil Yield Potential Classification (FYPC). See FEIS Appendix I for a detailed description of FYPC.

Table 3-173. Geologic formations on the Bighorn National Forest and Fossil Yield Potential Classification.

Formation	Approximate Age²¹ or Geologic Era	Formation Characteristics	FYPC
Morrison and Cloverly	70 million years Cretaceous	Colorful reds and pinks of badlands clays, muds and sandstones deposited on tropical, swampy floodplains which were inhabited by dinosaurs.	5
Goose Egg	250 million years	Bright red (iron oxide) deposited by tidal flats.	2
Tensleep Sandstone	300 million years Pennsylvanian	Thin but extensive sheet of sand deposited by shallow waters with strong currents.	2
Amsden Formation	300 million years Pennsylvanian	Local sand deposits.	3
Madison Limestone	335 million years Mississippian	Formed under warm and quiet waters, many fossils from the remnants of animals that were deposited.	2 or 3
Bighorn Dolomite	465 million years Ordovician	Same as Madison limestone. Dominant formation along North Tongue River west of Burgess Jct.	2 or 3

²¹ Ages and formations are from Bonney and Lorraine, 1960 and Darton, 1906.

Formation	Approximate Age²¹ or Geologic Era	Formation Characteristics	FYPC
Gallatin Limestone	Cambrian	Deep, clear sea with quiet water.	2 or 3
Gros Ventre	Cambrian	Formed by mud and tidal flats.	3
Flathead Sandstone	Cambrian (nearly 600 million years)	Sandy beaches at edge of sea.	3
Granite	Pre-Cambrian (2.5 billion years)	Formed deep in the crust and forced upwards into the sedimentary layers about 60 million years ago.	1

Minerals

Mineral resources on federally owned lands are separated into three categories—locatable, leasable, and mineral materials (salable)—by statutory and regulatory direction. The following section discusses locatable and salable minerals. Leasable minerals (oil/gas) are addressed separately in the Oil and Gas section of this chapter. Some areas on the Forest, such as administrative sites, highway right-of-ways, campgrounds, ski areas, and reservoirs, have been withdrawn from exploration and development of minerals. The Bureau of Land Management (BLM), Wyoming State Office maintains records of existing land withdrawals on the Forest.

Locatable Minerals

Locatable minerals are those valuable deposits subject to exploration and development under the Mining Law of 1872 (as amended). Examples include iron, gold, copper, silver, lead, and zinc. The public has statutory right to explore for, claim, and mine mineral deposits found on federally owned lands subject to U.S. mining laws. Through a Memorandum of Understanding with the BLM, the Forest Service administers most aspects of operation under the U.S. mining law on NFS lands.

On the west side of the Big Horns, there is an active operation producing bentonite for medicinal purposes; the operation is located a few miles northwest of Meadowlark Lake. There are several other bentonite claims about one mile west of that operation. Starch (1981) indicates bentonite reserves of 45 to 54 million tons on the west flank of the Big Horn Mountains.

According to Hausel (1998), the Big Horn Mountains are part of the Wyoming craton, an ancient continental core complex more than 2.5 million years old (Gurney et al. 1991) that has had little deformation over a very long period. The Wyoming craton underlies Wyoming and portions of Colorado, Idaho, Montana, Nevada, and Utah. It consists of an Archean basement (Wyoming Province); mainly granite, gneiss, and supracrustal metamorphic rocks exposed during several Laramide uplifts. The Wyoming Province underlies most of Wyoming and Montana and forms the core of the Wyoming craton. Regional metamorphic events occurring approximately 1.7 to 1.9 million years ago,

allowed the intrusion of kimberlitic and lamprolitic dikes containing diamonds (Hausel 1998).

Several mining districts, established principally for gold, existed in the area of the Bighorn National Forest around the turn of the twentieth century. These included Bald Mountain, Walker Mountain, Willett Creek, East Goose Creek, Kelly Creek, and Bull Camp. There was no significant production from any of these districts. During the 1860s, placer activities also took place in the North Fork of the Crazy Woman Creek area. Some exploration for gold may be sporadically occurring in the Bald Mountain area. The other mining districts are currently dormant.

There is a deposit of niobium (columbium) and tantalum, rare earth elements, in the Cookstove Basin area. At present, the economic value is unknown. Some copper has been found in the Walker Mine located about two miles southwest of Walker Mountain, and a copper prospect has been reported north of Powder River Pass in the southern Bighorn Mountains.

A U.S. Bureau of Mines study (Osterwald et al. 1966) indicates a monazite deposit with 8.8% thorium near Bald Mountain. Ilmenite, zircon, and magnetite were also found. Currently, there is no exploration for, or development of, these minerals on the forest.

Within the Cloud Peak Wilderness, most of the past mineral activity has been in the north half along Edelman, Goose, and Medicine Lodge Creeks, and on the Edelman Creek Fault and associated faults south of Coffeen Park. Mining activity consisted of placer and underground exploration for precious and base metals. The Cloud Peak Wilderness is withdrawn from mineral entry and consequently there is no current mining activity in that area.

Some platinum and copper deposits have been found in the Cloud Peak Wilderness but not in sufficient quantity or quality to be profitable. Small, high-grade uranium deposits are found in the Little Mountain area, approximately 12 miles west of Cookstove Basin off the National Forest. Most deposits are 500 tons in size and may contain only a few tons or pounds of ore (Osterwald et al. 1966). Similar deposits may exist on the northern end of the forest.

The Mississippian Madison limestone is a potential source of high-calcium limestone for chemical and metallurgical uses. The limestone is located along both flanks of the forest and across the extreme northern half. A quarry operation was proposed several years ago one mile west of Story, Wyoming.

Gypsum deposits occur along the flanks of the Big Horns. They are not being explored or mined at this time. Uneconomic deposits of nickel, talc, manganese, and asbestos have been described within the forest boundary.

Exploration, development, and production of locatable minerals will continue to be dependent on market prices. With increased prices, more activity will probably be directed toward locatable minerals, especially base and precious metals. Areas containing known

reserves will experience continued development and production. Exploration will search for additional reserves adjacent to, or further delineate, a known mineral deposit.

With improved mining technology and a better mineral market, the demand for bentonite, calcium, uranium, and some rare earth elements may prompt development and production of these minerals on the Forest, in areas open to mineral entry, at some time in the future.

Most of the current mining activity on the Forest is considered “recreational.” This includes panning, and suction dredging with a suction diameter of 3 inches or less for short durations in specified timeframes. The U.S. Army Corps of Engineers considers the use of a 3-inch or smaller suction dredge “recreational” and does not require a 404 permit for this activity. Wyoming’s Department of Environmental Quality issues permits for these activities. The Letter of Authorization issued by the state serves as the Notice of Intent. The Forest Service then assumes responsibility for inspecting the mining operation and making sure it complies with spacing and other requirements in the Letter of Authorization. The state’s guidelines are some of the most stringent in the nation.

Locatable/Salable Mineral Materials

Mineral construction materials are generally low-value deposits of sand, clay, and stone used for building materials and road surfacing. Extracting these materials from NFS land is at Forest Service discretion. The major statutes are the Minerals Materials Act of 1947, Surfaces Resources Act of 1955, and the Federal Highways Act of 1958. The Forest has identified potential aggregate source on the Forest. The demand for gravel will increase as campgrounds, forest roads, and county roads are improved. There are off-Forest sources to meet private needs.

Sources of sand and gravel are available on the Forest. They include alluvial, terrace, pediment, and glacial materials. These common varieties include granite, dolomite, limestone, and sandstone.

“Leopard rock” is a local term for an ornamental building stone found north of U.S. Highway 14 just inside the Forest boundary. There is an on-going local demand for this rock. Moss agates are found between Spanish Point and Mill Creek adjacent to the Forest. The deposit does not appear to extend on the Forest.

An increase in demand of common variety minerals may be expected as road construction and maintenance occurs on the forest. Since there are ample reserves of these minerals on private lands, demand for minerals for off-Forest uses is not expected to be significant. However, increased work associated with federal and state highway construction, reconstruction, and maintenance may increase the demand for construction materials and the Forest may be obligated to provide material under the Title 23, Section 317 of the Federal Highways Act.

The Forest Service may request withdrawal of areas from mineral activity if the activity might conflict with other management objectives. Currently, 11,361.82 acres on the Forest are withdrawn for locatable mineral entry. These withdrawals are for site-specific

administrative purposes: for example, special designated areas, roadsides, reservoirs, ski areas, recreation areas, administrative sites, and campgrounds.

ENVIRONMENTAL CONSEQUENCES

General Effects

Locatable/Salable Minerals (Mineral Materials)

The areas with moderate to high geologic potential for discovery of locatable minerals include Bald Mountain, Walker, Willett Creek, East Goose Creek and Kelly Creek. There have been exploratory core drilling operations in each of these complexes, but there has been no further interest shown. Market prices, commodity supply and demand, and technological advances will influence future interest in exploration, development, and production.

Common variety minerals may be sold for fair market value or disposed of through free use in any of the proposed alternatives. Potential aggregate sources have been identified across the Forest. The demand for gravel will increase as Forest Service and county roads are improved. Sources to meet private needs are available off-Forest.

Paleontological Resources

Paleontological resources occur on the Bighorn National Forest and range from Paleozoic invertebrates such as trilobites from the Flathead Sandstone to dinosaurs from the Cretaceous Cloverly Formation. They are managed in a similar fashion to heritage resources, although they are discussed as a fossil resource in this section of the document. Unlike heritage resources, federal statutes do not exist that specifically protect paleontological resources, except under Organic Administration Act and the Cave Protection Act. Petrified wood collecting is regulated by 36 CFR 228.62(e), however, invertebrate fossils are currently not regulated.

These resources may be collected from the ground/rock surface (i.e., not by digging or other disturbance) by the public, for personal, non-commercial use, and may require a permit, depending upon the level and intensity of collection expected. Research conducted on any type of paleontological resource requires a permit. Vertebrate fossils are regulated by 36 CFR 261.9(i), which prohibits their collection without a permit. Permits are issued to applicants meeting qualifications. Commercial collection of paleontological resources is prohibited.

Effects to these resources are similar under all alternatives since potential impacts will be mitigated as a result of surveys conducted prior to site-specific project implementation. Alternatives with a higher level of resource management activities, or conversely, locatable mineral acres not withdrawn, will have a greater likelihood of identifying these resources.

Table 3-174. Acres of Fossil Yield Potential.

FYPC	Acres	Percent of Forest
1	578,311	52
2	166,142	15
3	357,507	32
4	0	0
5	9,899	1

Direct and Indirect Effects

Effects from Management Area Allocations: The Forest Service may request that the BLM withdraw certain areas from mineral entry, if the activity has the potential to conflict with other management objectives. Existing withdrawals are not based on management area allocations but related to site specific requirements. This table shows only the relative change between alternatives based only on management area allocations.

Table 3-175. Effects on availability of locatable mineral withdrawals by alternative

Land Use Category	Less Impact ← Relative Impact → More Impact to mineral availability					
	E	A	D-FEIS	D-DEIS	B	C
Land Available for locatable minerals						

Acres are based on management area allocations and GIS acres.

Under the 1872 mining law, the Forest Service is required to provide reasonable access for locatable minerals exploration and development. The analysis of this reasonable access is addressed during site-specific project analysis.

Withdrawal of areas for minerals activity is not implemented in the Forest planning process. In order to obtain a withdrawal, the Forest Service must first request that the Bureau of Land Management (BLM) withdraw the lands. The Forest Service must then complete an Environmental Analysis (EA) for the withdrawal and a Mineral Potential Report (MPR) for the given lands. Based on the information in the EA and MPR, the BLM may or many not choose to grant the withdrawal. Areas such as recommended wilderness are not withdrawn until Congress specifically designates such an area. However, until designation is completed, activities in these areas may not preclude future designation.

Cumulative Effects

The cumulative effect boundary considered here is the entire Forest area and the effects are expected to occur over the life of the Revised Plan. Areas withdrawn from mineral entry would result in a loss of potential production of placer metals and gemstones. Adverse impacts to the locatable minerals resource from most to least are C, B, D-DEIS, D-FEIS, A, and E. The cumulative effects table at the beginning of this chapter includes the list of past, present, and reasonably foreseeable future activities that were considered with regard to cumulative effects to development of mineral resources.

Oil and Gas

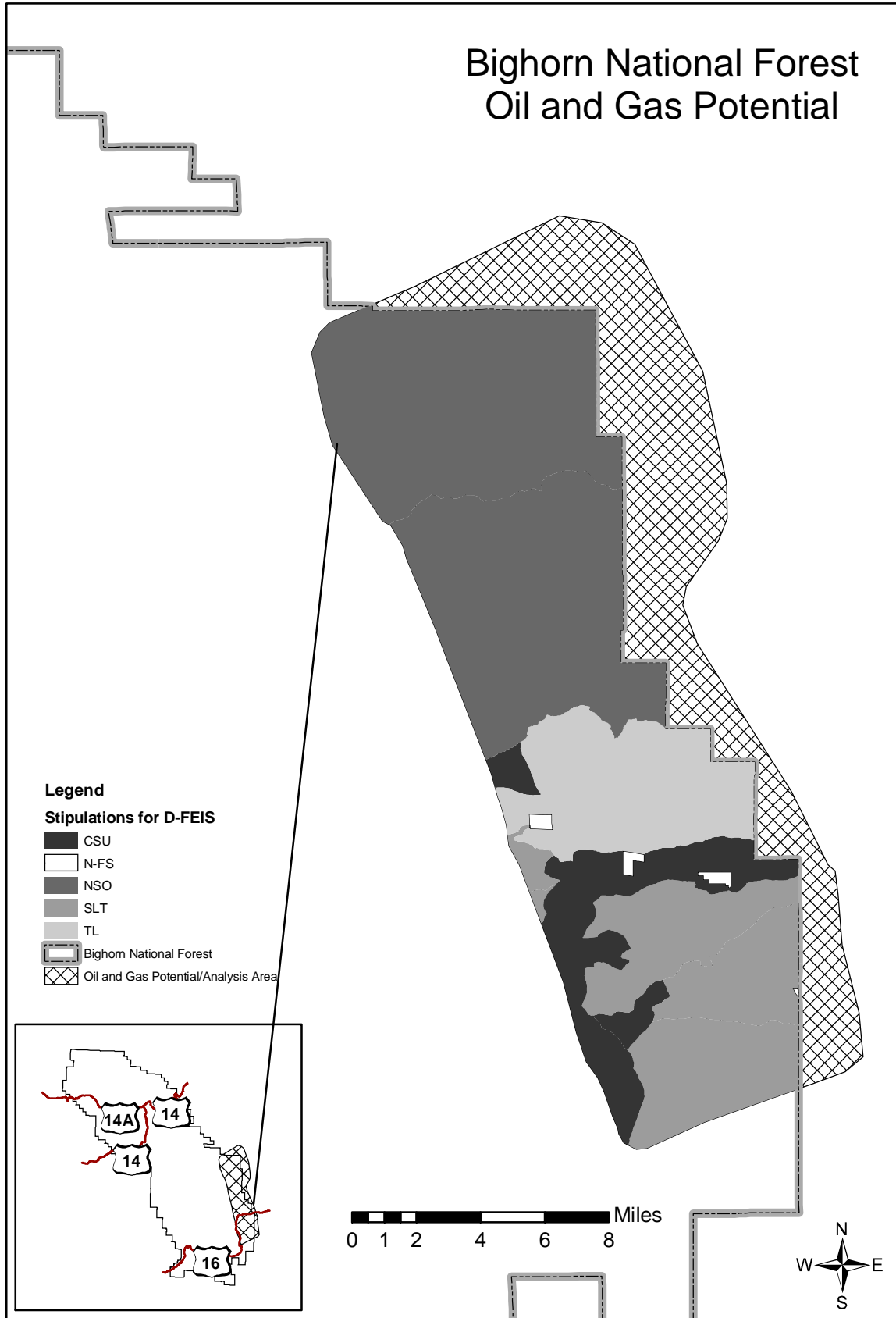
Introduction

The Federal Onshore Oil and Gas Leasing Reform Act of 1987 expanded the authority of the Secretary of Agriculture for oil and gas leasing and authorized the Secretary to develop procedures and regulations governing leasing and development of oil and gas resources in the National Forest System (NFS). The regulations, completed on April 20, 1990, set forth procedures for making leasing decisions, and required a schedule for analyzing lands that have not already been analyzed for leasing. The leasing analysis for the Bighorn National Forest was scheduled for the forest plan revision and is being conducted as part of this analysis. After the Forest Service completes required National Environmental Policy Act analysis and oil and gas decisions, the Bureau of Land Management (BLM) can offer the leases for sale consistent with the decisions.

Leasing decisions are based on and closely tied to the Revised Plan. The following oil and gas analysis applies to about 7,500 acres of federal minerals in the area of the Forest west of Buffalo, Wyoming (BLM 2004), as shown on the following map. There has been historical interest in exploration in this area, even though the area has low potential for occurrence of oil and gas resource and low potential for development. Most of the Forest, approximately 1 million acres, is located on an uplift of crystalline rocks, lacks sedimentary rocks, and has no known oil and gas occurrence potential.

With management responsibility and authority for the federal mineral estate, the BLM also plays a role in the analysis and management of oil and gas resources underlying NFS lands in accordance with the 1991 Interagency Agreement for Oil and Gas Leasing between the Forest Service and BLM. An oil and gas analysis addresses all federal minerals including those under non-federal surface (split estate) lands with oil and gas development potential within the boundaries of the NFS units to which this analysis applies. Based on this oil and gas analysis the Forest Service will issue leasing decisions pursuant to 36 CFR 228.102, and the BLM will issue decisions for leasing federal mineral estate under Forest Service administered surface and under non-federal surface (split estate lands) within Forest Service units, as appropriate.

Map 3-2. Oil and gas potential on the Bighorn National Forest and analysis area.



Legal and Administrative Framework

Oil and gas resources on NFS lands are managed under a large body of laws and regulations. A few, however, are specific to the mineral resource itself and provide direction on the disposition of federally owned oil and gas resources, as well as administration of surface activities associated with development of these resources.

Mineral Leasing Act of 1920 – This act authorizes the Secretary of Interior to issue leases for the disposal of certain minerals (currently applies to coal, phosphate, sodium, potassium, oil, oil shale, gilsonite, and gas). The act applies to National Forest lands reserved from the public domain, including lands received in exchange for timber or other public domain lands and lands with minerals reserved under special authority.

Mineral Leasing Act for Acquired Lands of 1947 - This act states that all deposits of coal, phosphate, oil, oil shale, gas, sodium, potassium, and sulfur that are owned or may be acquired by the United States and that are within lands acquired by the United States may be leased by the Secretary of Interior under the same conditions as contained in the leasing provisions of the mineral leasing laws. No mineral deposits shall be leased without the consent of the head of the executive department having jurisdiction over the lands containing the deposit and subject to such conditions as that official may prescribe.

Mining and Minerals Policy Act of 1970 - This act states that the continuing policy of the federal government is to foster and encourage private enterprise in the development of economically sound and stable domestic mining and minerals industries and the orderly and economic development of domestic mineral resources.

Energy Security Act of 1980 - This act directs the Secretary of Agriculture to process applications for leases and permits to explore, drill, and develop resources on NFS lands, notwithstanding the current status of any management plan being prepared.

Federal Onshore Oil and Gas Leasing Reform Act of 1987 - This act expands the authority of the Secretary of Agriculture in the management of oil and gas resources on NFS lands. Bureau of Land Management cannot issue leases for oil and gas on NFS lands over the objection of the Forest Service. The Forest Service must approve all surface-disturbing activities on NFS lands before operations commence.

Title 36 of the Code of Federal Regulations, Part 228E – These regulations specify how the Forest Service will implement the Leasing Reform Act. They prescribe methods by which the Forest Service will schedule and make oil and gas leasing decisions, and how it will subsequently manage oil and gas operations on NFS lands. These regulations lay out the process for determining lands administratively available for leasing, including the projection and analysis of post-leasing activity and the designation of stipulations. These regulations describe the Forest Service process for authorizing the BLM to offer leases for sale.

Title 36 CFR 228.102(c)(2) requires a leasing analysis to identify alternatives “including that of not allowing leasing.” For this analysis, the No Oil and Gas Leasing Alternative

(Chapter 2 FEIS) is the no leasing alternative. All lands under that alternative are not administratively available for leasing.

Title 43 Code of Federal Regulations, Parts 3000 and 3100 – These regulations provide the regulatory basis for federal leasing by the BLM. Both the Forest Service and BLM have responsibility for leasing decisions on the federal mineral estate underlying NFS administered lands. However, BLM is solely responsible for making leasing decisions on split estate lands where the federal government owns the mineral estate (oil and gas) but does not own the surface. These regulations describe rights, responsibilities, and operating requirements, and how the BLM will offer competitive and non-competitive leases.

Executive Order 13212, Energy Policy - On May 18, 2001, President Bush issued Executive Order 13212 (EO 13212) to “take additional steps to expedite the increased supply and availability of energy to our Nation”. On July 13, 2001, the Secretary of Agriculture approved the Forest Service Energy Implementation Plan in accordance with the Presidents EO 13212.

Terms Used

There are several terms used in this chapter, that are specific to oil and gas leasing. A brief description of these terms is given below.

Controlled Surface Use (CSU): A type of lease stipulation under which use and occupancy is allowed (unless restricted by another stipulation), but identified resource values require special operational constraints that may modify the lease rights. CSU is used for operating guidance, not as a substitute for NSO or TL stipulations.

Development Potential: Oil and gas development potential is based on estimated average drilling density (BLM 2001) and is defined as follows:

- ◆ High – over 1.0 well/township/year
- ◆ Moderate – 0.2 to 1.0 wells/township/year
- ◆ Low – less than 0.2 wells/township/year
- ◆ Very Low – less than 0.02 wells/township/year
- ◆ Zero – no drilling.

Lease Notice (LN): Lease notices are attached to leases to provide more detailed information concerning limitations that already exist in law, lease terms, regulations, or other operational orders. A LN addresses special items the lessee should consider when developing a plan of operations, but does not impose new or additional restrictions.

Guidance in the use of Lease Notices is found in the Uniform Format for Oil and Gas Lease Stipulations (1989), BLM Manual 3101, and 43 CFR 3101.1-3. Lease Notices attached to leases should not be confused with Notices to Lessees (NTL).

Not Administratively Available (NAA): Designation given to lands that have been identified in a leasing analysis as closed to leasing through exercise of management direction .

No Surface Occupancy (NSO): A type of lease stipulation under which use or occupancy of the land surface for fluid mineral exploration or development is prohibited to protect identified resource values.

Notices to Lessees (NTL): The NTL is a written notice issued by the authorized officer. NTLs implement regulations and operating orders and serve as instructions on specific items of importance within a specified area.

Occurrence Potential

- ◆ **High** – There is a demonstrated existence of petroleum source, reservoir quality strata, and traps. Areas of high potential have discovered oil occurrences or free oil recovery from well tests.
- ◆ **Moderate** – There is direct or indirect geological evidence that petroleum source, reservoir quality strata, and trapping mechanisms are present. Discovered occurrences are not present but there may be shows of oil in core or drill stem tests.
- ◆ **Low** – There is geologic evidence that a petroleum source, reservoir quality strata, or trapping mechanisms are not present.
- ◆ **None** – There is demonstrated absence of a petroleum source, reservoir quality strata, or trapping mechanisms. Demonstrated absence means physical evidence documented in geologic literature.

Standard Lease Terms (SLT): Standard lease terms provide the lessee the right to use so much of the leased lands as is necessary to explore for, drill for, mine, extract, remove, and dispose of all the oil and gas in the leasehold subject to any attached stipulations, restrictions deriving from specific, non-discretionary statutes, and such reasonable measures as may be required by the authorized officer to minimize adverse impacts. Under standard lease terms, the authorized officer has limited authority to modify the site location and design of facilities, to control the rate of development and timing of activities, and to require other mitigation (BLM Form 3100-11 and 43 CFR 3101.1-2).

Stipulation: A provision that modifies standard lease terms and is attached to and made a part of the lease. Stipulations have been developed using the Uniform Format for Oil and Gas Leasing Stipulations, March 1989. Stipulations include controlled surface use (CSO), no surface occupancy (NSO), and timing limitations (TL).

Timing Limitation (TL): A type of lease stipulation that prohibits surface use during specified periods if surface use is greater than 60 days, i.e. seasonal restrictions, to protect identified resource values. This stipulation does not apply to the operation and maintenance of production facilities unless analysis demonstrates the continued need for such mitigation and that less stringent, project-specific mitigation measures would be insufficient.

Historical Summary

In accordance with the Federal Onshore Oil and Gas Leasing Reform Act of 1987 and its implementing regulations (completed April 20, 1990), reasonable foreseeable development

(RFD) information used in this FEIS is derived from *A Brief Review of the Oil and Gas Potential on the Bighorn National Forest, Wyoming* (BLM 2004) and *Reasonably Foreseeable Development Scenario for Oil and Gas Development in the Buffalo Field Office Area, Campbell, Johnson, and Sheridan Counties, Wyoming* (BLM 2001). A more detailed RFD scenario on the Bighorn National Forest may be completed during the life of the Plan, dependent upon future oil and gas demand.

Historically, the Bighorn National Forest has had no oil and gas production and very little exploration. Geophysical exploration occurred along the eastern flank of the Big Horn Mountains from Story south to Buffalo in the mid 1980s. This activity was based on a theory that there might be thrusting of granitic rocks over the sedimentary formations. A well was drilled in the same area in 1984 through the Piney Creek Thrust west of Story, Wyoming. That well confirmed the overthrust theory, but did not confirm the presence or trapping of oil or gas. That well was plugged and abandoned shortly after being drilled.

East of the Forest in the Powder River Basin (PRB), oil and gas development is booming. However, on the Forest the reservoir rocks that produce in the PRB fields have been removed by erosion and are not present on the Forest or are too shallow to have potential for production. Consequently, there has been very little interest in exploration on the Forest.

Background Information on Oil and Gas Leasing

Title 36 CFR 228 (Subpart E) regulations prescribe methods by which the Forest Service will make oil and gas leasing decisions. These regulations lay out the process for determining lands administratively available for leasing and the Forest Service process for authorizing the BLM to offer leases for sale.

A lease, by itself, does not permit ground-disturbing activities, but because it conveys certain rights to the lessee, any mitigation measure necessary to protect other resources from ground-disturbing activities need to be addressed before the lease is issued (36 CFR 228.102(c)). Consequently, the leasing stage level of analysis (stage 1) identifies effects on other resources from potential activities and specifies necessary restrictions, if any, beyond those imposed by standard lease terms. Stipulations attached to leases specify such restrictions.

At the exploration stage (stage 2), when a lessee or designated operator has proposed to drill an exploration well on a lease, the Forest Service has the responsibility and authority to approve the Surface Use Plan of Operation (SUPO), with conditions, as part of the Application for Permit to Drill (APD) (36 CFR 228.107 and 228.108). Environmental analysis of the proposed drilling project identifies effects on other resources from the proposed activity and specified mitigation consistent with Forest Plan direction, terms of the lease, and direction in 36 CFR 228.108. Approved mitigation measures are included as Condition of Approval (COA) with the SUPO. The Forest Service must approve the SUPO as part of the APD, for which BLM provides final approval, with mitigation measures, if any are necessary, before a well can be drilled.

At the development stage (stage 3), when a lessee or designated operator proposes to develop discovered resources, the Forest Service has the responsibility and authority to approve the surface use portion of a development plan, which could include one or more wells. Environmental analysis of the proposed development project identifies effects on other resources from the proposed activity and specified mitigation measures consistent with Forest Plan direction, terms of the lease, and direction in 36 CFR 228.108. Identified mitigation measures are included as COAs with an approved development plan and an approved SUPO and APD for each well. Development activity can proceed only after the Forest Service and BLM have approved the development plan with specified mitigation measures, if any.

Forest Service and BLM personnel must conduct periodic inspections of exploratory and development drilling operations and production activities to ensure compliance with mitigation measures (36 CFR 228.112) and other applicable regulatory authorities.

AFFECTED ENVIRONMENT

Most of the Forest is located on uplifts of Precambrian crystalline rocks such as granite and granitic gneiss, and as a consequence, has little to no known oil and gas occurrence potential. Areas with potential for oil and gas resources occur on the flanks of these uplifts in sedimentary rocks, on the flanks of the Big Horn Mountains and along the Forest boundary.

Sedimentary rocks in peripheral areas of the Forest include documented reservoir rocks, source rocks, seals, and traps. However, much of this sedimentary section on the Forest is absent due to erosion or is very shallow and offers only indirect evidence of the presence of oil and gas traps. In limited areas of the Forest such as the extreme northwest and southeast area near Buffalo, Wyoming, crystalline rocks at the surface have been thrust over a deeper sedimentary section.

The area of the Forest analyzed for leasing is on the southeast flank of the Bighorn Uplift, where crystalline rocks, such as granite and granite gneiss, have been thrust over deeper sedimentary rocks. This area has some potential for oil and gas resource occurrence, though the existence of traps in the subthrust sedimentary section has not been confirmed.

Demand Assessment

Occurrence potential for oil and gas throughout the Forest is minimal. Consequently, there are no identified areas on the Forest with the demand potential for oil and gas development in the near future (BLM 2004). Because only minor parts of the Forest have low and speculative potential for the occurrence of oil and gas resources, only the part of the Forest identified by the BLM (2004) is analyzed for oil and gas leasing.

ENVIRONMENTAL CONSEQUENCES

Direct and Indirect Effects

Resource Protection Measures

Standard lease terms (SLT) are part of every oil and gas lease and require compliance with laws and regulations to ensure protection of other energy, mineral, and surface resources, such as soil, water, vegetation, cultural, and threatened and endangered species. SLT have the lowest level of restriction on oil and gas exploration and development activities and meet Forest Service policy and direction to encourage development of mineral resources.

SLT permit year-round occupancy of leased lands, provide full access, and provide the highest potential for discovery and development of oil and gas resources. They require an operator to minimize adverse impacts to air, water, and soil, visual, cultural, and biological resources and to other land uses or users.

Some uncertainty about potential operational constraints is inherent in SLT with respect to conditions on the ground that may change after issuance of a lease. For example, if threatened and endangered plant and animal species or cultural resources are present, then certain operations constraints, including (rarely) preclusion of occupancy, may be required at the time operations are proposed. Known potential for such types of situations may be conveyed in a LN for the affected areas. Effects to resources can usually be mitigated but may substantially increase the operator's costs.

In addition to SLT, supplemental lease stipulations may be necessary if authority to control the activity does not exist under current laws, regulations, or orders. If potential negative effects to surface resources can be mitigated under SLT by moving the drill site no more than 200m or delaying operations no more than 60 days (43 CFR 3101.1-2), then no additional stipulations are necessary.

The alternatives represent a range of potential scenarios for oil and gas leasing, based on management area allocation and provisions for protecting specific resources through the use of lease stipulations. Stipulations for each management area under each alternative were developed using existing laws, regulations, and the standards and guidelines outlined in the Revised Plan. In addition, stipulations for protecting specific resources were developed based on need for protection beyond SLT, and on existing laws, regulations, and standards and guidelines outlined in the Plan. All alternatives were considered here, except for the No Oil and Gas Leasing Alternative, (Chapter 2 of the FEIS). Under all alternatives, except the No Action Alternative, all land located in the analysis is available for oil and gas leasing and there are no areas designated as not administratively available (NAA), such as wilderness and wild and scenic rivers.

Determination of Effects

This section outlines the methods used to determine the magnitude of effects that constraints on development would have on the level of oil and gas exploration and development. The magnitude of the effects was determined by calculating the number of acres where oil and gas activity is constrained by lease stipulations. The magnitude of effects varies by alternative depending on the application of stipulations by alternative. Alternative leasing decisions, consistent with Revised Plan alternatives, are discussed in the sections following.

Effects by Leasing Availability Decisions

Decisions to make lands not administratively available (NAA) for leasing or not to authorize lands for leasing precludes the exploration and the potential discovery of oil and gas resources and can make subsurface federal mineral estates unrecoverable. In the area being considered for oil and gas leasing availability, all alternatives, except the No Action Alternative, make all lands available for leasing. Consequently, all alternatives, except the No Action Alternative, offer potential for exploration and development of oil and gas resources.

Effects of Leasing Stipulations

Stipulations for new leases were developed to implement the standards and guidelines in the Revised Plan. Lease stipulations can restrict the placement, number, and type of wells and facilities, reduce exploration and development opportunities, and increase drilling and operational costs. Types of stipulations are discussed below. Locations of the various resources and specific management areas where the stipulations would apply were mapped for each alternative. Throughout this analysis, resource inventories were updated to include the best available data at the time of analysis.

Lease stipulations are a modification of standard lease terms and are attached to a lease. Stipulations provide greater protection for identified resources and greater mitigation of negative effects than SLT. See Appendix B of the Revised Plan, for a more detailed discussion on leasing stipulations.

Effects by Alternative

The following table displays acres of land in the analysis area that would be made not available for leasing, available for leasing, and the area that would be affected by each type of stipulation by alternative. The total acres include the entire federal mineral estate in the analysis area, whether or not the federal government owns the surface.²² Oil and gas alternative maps showing the spatial distribution of leasing stipulations, by alternative, are available in the project record.

²² There are areas where the federal government owns the mineral resource below ground but does not own the surface. BLM is responsible for leasing decisions on split estate lands.

Table 3-176. Acres of oil and gas development potential in analysis area, by leasing availability category, stipulation, and alternative.

	Alt A	Alt B	Alt C	Alt D-DEIS	Alt D-FEIS	Alt E
Total federal mineral estate in analysis area	85,690	85,690	85,690	85,690	85,690	85,690
Acres available for leasing	85,690	85,690	85,690	85,690	85,690	85,690
% of available lands within the analysis area, affected by leasing stipulations						
Not Administratively Available (NAA)	0	0	0	0	0	0
Standard Lease Terms (SLT)	60	10	10	22	23	27
No Surface Occupancy (NSO) by MA	27	64	68	51	51	3
Timing Limitation (TL)	11	10	10	16	14	8
Controlled Surface Use (CSU)	1	15	11	11	11	61
TOTAL*	99	99	99	99	99	99

*Approximately 1% of the analysis area is comprised of privately held land, which is not subject to leasing stipulations imposed by management area constraints determined by the Forest Service.

All lands are available for oil and gas development under all of the alternatives, except the No Action alternative, but differ in the degree of stipulations that apply, based on management area constraints. Alternatives C and B are the most restrictive, because of the relatively larger amount of land area within the analysis area designated within Management Area Category 3, due to the NSO stipulation, with Alternative E being the least restrictive because of the negligible amount of land area allocated to management areas with the NSO stipulation. The following table compares the degree of constraints that would be imposed on oil and gas development that could occur after leasing, under each alternative.

CHAPTER 3
AFFECTED ENVIRONMENT & ENVIRONMENTAL CONSEQUENCES

Table 3-177. Relative effects of alternatives on potential oil and gas development within the analysis area.

Stipulation	Less Restrictive ← Relative Restriction → More Restrictive for oil and gas development					
Not Administratively Available (NAA)	No difference between alternatives, as all areas are available					
No Surface Occupancy (NSO)	E	A	D-DEIS	D-FEIS	B	C
Timing Limitation (TL)	E	C	B	A	D-FEIS	D-DEIS
Controlled Surface Use (CSU)	A	B	C	D-FEIS	D-DEIS	E

Effects Based on Management Area Prescriptions

Management areas place limits on oil and gas activities due to standards and guidelines outlined in the Plan. Some management areas, such as wilderness, are not administratively available (NAA), while others allow oil and gas development, but prohibit surface-disturbing activities, or have other standards and guidelines which stipulate restrictions on standard lease terms (SLT). There are no management areas within the analysis area that are not available for leasing. Management areas that do not require an area-wide stipulation may still include constraints designed to protect specific resources. Most of the effects to oil and gas leasing decisions are related to relatively larger allocation of land area to Management Area 3.31 (year round motorized, back country recreation) in Alternatives C, D-DEIS, and D-FEIS and Management Area 3.5 (plant and wildlife habitat management) in Alternatives A, B, and C. Because of the distribution of management areas with an NSO stipulation, in Alternative C, that alternative is the most restrictive relative to the other alternative

The table below displays by alternative the acres in each management area subject to a specified stipulation. Appendix B of the Revised Plan also describes the relative amount of land area allocated to different management area prescriptions.

Table 3-178. Percent of potential oil and gas development/analysis area with standard lease terms or stipulations, by management area and alternative.

MA	Stip.	Alt A	Alt B	Alt C	Alt D-DEIS	Alt D-FEIS	Alt E
1.2 Recommended Wilderness	NSO	0	0	11	0	25	0
1.31 Backcountry Recreation, Nonmotorized	NSO	0	12	0	11	0	1
1.32 Backcountry Recreation, Nonmotorized Summer	NSO	1	0	0	0	0	0
1.33 Backcountry Recreation, Limited Motorized Use	NSO	4	0	0	2	0	2

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MA	Stip.	Alt A	Alt B	Alt C	Alt D-DEIS	Alt D-FEIS	Alt E
1.5 National River System-Wild	NSO	0	2	3	0	0	0
2.2 Research Natural Areas	NSO	0	10	10	10	0	0
3.31 Backcountry Recreation - Year-round Motorized	NSO	2	0	31	28	25	1
3.4 National River System-Scenic	NSO	0	1	0	0	0	0
3.5 Plant and Wildlife Habitat Management	NSO	20	39	13	0	0	0
4.2 Scenery	CSU	1	11	11	11	10	1
4.3 Dispersed Recreation	CSU	0	4	0	0	2	0
5.11 Forest Vegetation	SLT	11	0	10	4	8	6
5.12 Rangeland Vegetation	SLT	18	0	0	9	7	0
5.13 Forest Products	SLT	30	10	0	8	8	8
5.4 Plant and Wildlife Habitat	CSU	0	0	0	0	0	59
5.41 Deer and Elk Winter Range	TL	11	10	10	16	14	8
5.5 Dispersed Recreation and Forest Products	SLT	0	0	0	0	0	13
8.21 Water Impoundments(Tie Hack)	SLT	1	0	0	0	0	0
0.00 Non-Forest Service	None	1	1	1	1	1	1
TOTAL		100	100	100	100	100	100

Effects Based on Management of Specific Resources

To implement the Revised Plan standards and guidelines, additional project level stipulations for management areas with standard lease terms (SLT), controlled surface use (CSU), and timing limitations (TL) will be applied to protect other resources such as wildlife, soil, water, riparian and fisheries resources. A no surface occupancy (NSO) stipulation will be applied to high erosion or geologic hazard soils and to slopes over 60%. The controlled surface use (CSU) stipulation will be applied to hydric soils (Cryaquolls - Map Unit 16), riparian areas, and to slopes from 40 to 60%. Maps showing the spatial distribution of additional leasing stipulations related to other resources are available in the project record.

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Table 3-179. Acres within the analysis area with additional project level stipulations to protect wildlife, soil, water, riparian, and fisheries resources.

Stipulation	Alt E	Alt D-DEIS	Alt D-FEIS	Alt C	Alt A	Alt B
High erosion and geologic hazard (NSO)	0	0	0	0	0	0
Slopes over 60% (NSO)	670	249	399	249	184	45
Slopes 40-60% (CSU)	4,407	3,461	3,349	2,694	2,336	807
Hydric soils (CSU)	550	550	550	550	422	448
Riparian (CSU)	5,249	4,496	4,384	3,725	3,744	1,977
TOTAL	10,876	8,756	8,682	7,218	6,686	3,277

In areas where NSO is applied, protection of steep slopes (over 60%) and high erosion and geologic hazard soils would impact oil and gas exploration. Effects would range from increased costs of drilling, to loss of access to oil and gas resources, to the loss of some rental and royalty income. The magnitude of the loss is reduced because, for the most part, steep slopes are accessible from adjacent land, and in areas even with very steep slopes and high density of steep slopes, it is often possible to find sites to locate well pads. Additionally, the costs of development on steep slopes would be higher than on adjacent gentler slopes. However, where there is a need to relocate a well, there could be some increased costs.

In the No Action Alternative, no lands are administratively available for oil and gas leasing; therefore and as a result, there would be no impacts to other resources from oil and gas activities. In all other alternatives, potential impacts to resources would be mitigated using project level stipulations for SLT, CSU, and TL, which require the lessee to minimize impacts to resources, and require reclamation. In addition, the use of standard lease provisions that allow for moving a well site up to 200 meters would provide avoidance of steep slopes in most cases. Alternatives D-DEIS and D-FEIS have approximately the same number of acres with the NSO and CSU stipulations protecting high erosion potential and geologic hazard, steep slopes, riparian areas, and hydric soils.

Riparian areas, woody draws, wetlands, and floodplains are protected by the hydric soils CSU stipulation discussed under Effects from Soils Management. In addition, ground-disturbing activities are restricted within 300 feet or the top of the gorge (which ever is greater) of streams containing aquatic, wetland or riparian dependent species listed as threatened, endangered, or sensitive (TES). Within these distance limitations, protecting aquatic, wetland or riparian-dependent, listed TES species would impact oil and gas exploration. Where there is a need to relocate a well, there could be some increased costs. Because the distance limitation for protection of aquatic-, wetland-, or riparian-dependent listed TES species is less than 200 meters, standard stipulations provide adequate protection.

Cumulative Effects

The cumulative effect boundaries considered here are the entire Forest area and the oil and gas producing basins to the east and west (i.e., the Powder River and Big Horn Basins, respectively). These effects are expected to occur over the life of the Revised Plan. The cumulative effects table at the beginning of this chapter includes the list of past, present, and reasonably foreseeable future activities that were considered with regard to cumulative effects to oil and gas development. Cumulative effects between the alternatives are expected to be relatively similar compared to direct and indirect effects.

In areas affected by NSO stipulations, wells would be displaced to areas outside the NSO area. Impacts to potential oil and gas development would include inability to develop the resource or increased costs of drilling directional wells. Areas beyond 1/8-mile of a surface location are considered inaccessible with current directional drilling technology for the purposes of this analysis. In some circumstances, leaving the oil and gas in place preserves the resource for future use.

The following table displays the area affected by inaccessibility, by alternative, due to NSO stipulations. The area affected is defined as the area inside the NSO area to within 1/8 mile of the boundary of the NSO area.

Table 3-180. Acres of NSO affected and not accessible due to NSO stipulations, by alternative.

Stipulation*	Alt C	Alt B	Alt D-FEIS	Alt D-DEIS	Alt A	Alt E
Affected (<1/8) by MA	9,964	9,159	4,254	5,615	12,703	1,576
Not accessible (>1/8) by MA	48,565	46,274	39,692	38,021	10,374	1,680
Total NSO by MA	58,529	55,433	43,946	43,636	23,077	3,256
NSO by resource stipulation	249	45	399	249	184	670
Total NSO	58,778	55,477	44,345	43,885	23,261	3,925

* Affected is defined as the area <1/8 mile inside the NSO boundary and Not Accessible refers to an area >1/8 mile inside the NSO boundary.

Effects from Accessibility

Access to leases across federal lands is controlled by Revised Plan standards and guidelines. The standards and guidelines are not specifically included in oil and gas leases but apply to the lessee, as well as any forest user. Generally, when a stipulation is applied to a lease, similar or identical restrictions will apply to the placement, construction, and use of access roads, pipelines, and powerlines on that lease.

Special Forest and Rangeland Products

Introduction

Special forest/rangeland products (SFPs) are mainly plant and fungi material that are gathered from forested lands or rangelands for personal use, for barter, for commercial resale, or for sale as a craft product. They can generally be categorized under five general areas: residential comfort and use, food, herbs and medicinal, decorative, and specialty items. Special forest/rangeland products can play a role in sustainable development and are thought to provide links to sustaining rural economies and contributing to economic diversification. As demand for these special products increases and new markets are created, harvest pressure on them may increase.

Legal and Administrative Framework

36 CFR 223.1: Trees, portions of trees, and other forest products on National Forest System lands may be sold for the purpose of achieving the policies set forth in the Multiple Use Sustained Yield Act as amended and the Forest and Rangeland Renewable Resources Planning Act of 1974, as amended and the Program there under.

36 CFR 261.6(a) Cutting or otherwise damaging a forest product except as authorized by a permit or federal law.

36 CFR 261.6(e) Loading, removing, or hauling a forest product acquired under any permit unless such product is identified as required in such permit.

36 CFR 261.10(c) Selling or offering for sale any merchandise or conducting any kind of work activity or service unless authorized by a federal law, regulation, or permit.

36 CFR 261.10(i) Violating any condition or term of a permit.

FSM 2467 - Sales of special forest products

FSM 2467.01 – Authority: Forest officers may sell other forest products under provisions set out at 36 CFR 223.1.

FSM 2467.02 – Objective: To sell other forest products where it would serve local needs and meet land management objectives.

FSM 2467.03 – Policy: Use management measures that perpetuate or increase the production of miscellaneous forest products within applicable objectives, standards, and guidelines of the Forest land and resource management plan. Recover the fair market value of such products when it is practical to do so.

FSM 2467.04 – Responsibility: See FSM 2404.2 for delegations of authority and assignments of responsibility to agency officials by organizational level. Regional Foresters shall develop appraisal and sale procedures, including defining the conditions of sale for forest products.

FSM 2467.1- Conditions of Use for Miscellaneous Forest Products: Conditions for use of miscellaneous forest products are set forth in FSH 2409.18, section 87.

FSM R2 Supplement No. 2400-96-2: 2431.31 - Minimum and Standard Rates.

2431.31a - Standard Rates. “Standard rates may be used for sale of all nonconvertible products and Special Forest Products. Forest Supervisors may establish higher standard rates when supported by an appraisal specialized for that product. Limit standard rates for convertible products to less than 4,000 CCF.”

Permits are generally required for harvest of special forest product resources, as well as for research collections. The permit regulates the manner in which forest product resources are harvested, provides information for monitoring the amount harvested. Collections that qualify as non-commercial research, educational use, or incidental personal use can be authorized through an administrative use permit or a free use permit or as provided in Bighorn Forest Manual Supplements.

Resource Protection Measures

Numerous forestwide and management area prescription standards and guidelines exist concerning vegetation.

AFFECTED ENVIRONMENT

Aspen and conifer transplants, Christmas trees, native seed, and boughs are examples of traditional requests for permits to acquire special forest products. Special forest products may be collected forestwide, though generally not from wilderness, recommended wilderness, or research natural areas. Existing uses are often tied to historical knowledge and patterns of use. Although technically not special forest products, personal use firewood, posts, and poles are sold to the public in a similar manner to the special forest products and are discussed here and in the timber section. According to the cut and sold reports, nearly 225 transplants were taken under permit on the Forest in fiscal year 2002. About 2,050 Christmas trees were sold in that same time. The Forest sold 302 hundred cubic feet (CCF) of posts and pole permits during each of the last two years. Firewood permits remain steady, with over 2,800 cords sold in FY 2002 that contribute to the other vegetation management volume offer.

In recent years, requests from the general public and scientific community for collection of additional and diverse special forest and rangeland plants for specific purposes have increased. Interest from Americans Indians continues in harvesting tepee poles and

collecting traditional use plants. Existing quantities of nearly all types of desired products are dependent upon ecological conditions and existing distributions of potential habitat as expressed by forest and/or non-forest covertypes (for more detailed information, refer to the Biodiversity section of this chapter).

Table 3-181. Association of special forest product with covertypes.

Special Forest Product	Cover Type
Christmas trees	Lodgepole pine, Spruce-fir, Douglas-fir
Moss	Montane Riparian within Lodgepole pine, Spruce-fir
Burls	Lodgepole pine, Spruce-fir, Ponderosa pine
Cones	Lodgepole pine, Spruce-fir, Ponderosa pine
Mushrooms	Lodgepole pine, Spruce-fir
Boughs	Douglas-fir, Lodgepole pine, Spruce-fir
Wildflowers & Seed	All Covertypes
Cuttings	Willow and Cottonwood
Transplants	Lodgepole pine, Spruce-fir, Ponderosa pine, Aspen
Firewood	All Forest Covertypes
Posts and Poles	Lodgepole pine, Spruce-fir

Permits for collection will generally be required. Care has to be taken to assure that native and desired non-native plant populations are not adversely affected due to over-harvesting and that conflicts with other uses are minimized.

Summary of Existing Condition

Unlike timber products and fish and wildlife products where harvest of these goods is strictly regulated and quantified, special products harvest is loosely regulated and difficult to quantify at times. This is largely due to the small-scale use of these special forest/rangeland products. As markets expand and demands increase, additional regulations may be necessary to sustain the resources and manage their collection.

In some cases, little is known about the distribution and abundance of some specialty plants. This can make it difficult to determine what level of harvest should be permitted while providing for long-term health and sustainability. Increasing emphasis on inventory and evaluation of life histories may become increasingly important as demand for these species increases.

Uses of and requests for Bighorn National Forest special forest and rangeland products continue to increase for both traditional and non-traditional types. Charge permits have long been required for such items as firewood, tree transplants, and Christmas trees; permits (charge or free) are generally required for removal of all types of products. Permit for harvest and/or locations of harvest may have to be regulated in order to assure sustainability of some of the non-traditional plant species.

ENVIRONMENTAL CONSEQUENCES

Direct and Indirect Effects

The requests for special forest/rangeland products will continue to increase regardless of the alternative, though access to them will vary. Alternative C has more recommended wilderness, thus less access, while Alternatives A and E could provide easier access through timber sale roads. The number of permits issued for their use will be independent of the alternative selected.

Fire increases the potential availability of traditionally collected mushrooms. The greatest acres of potential wildland fire use would be in Alternatives C and B, as they provide for the least acres of active management. However, they also potentially provide the least access to these areas.

Alternatives E, A, D-DEIS, and D-FEIS, respectively, offer higher levels of open and maintained roads, that would maintain or increase opportunities for the general public to access and harvest these products. Access to harvest activities is an indicator of how much of the Forest could be used to collect special forest/rangeland products as some of the roads used to access timber harvest could be kept open seasonally for a few years after harvest for just that activity. Alternatives E and A provide the most access for special forest products collection and would be the most favorable to their collection; Alternatives C and B provide the least. Alternatives D-DEIS and D-FEIS are in between them.

Cumulative Effects

The cumulative effects table at the beginning of this chapter includes the list of past, present and reasonably foreseeable future activities that were considered with regard to cumulative effects to the special forest/rangeland resource. The next 15 years are considered the time span for cumulative effects, and the proclaimed Forest boundary is the cumulative effects area. For special forest products, the cumulative effects are in direct proportion to the direct and indirect effects described above.

The cumulative effects of vegetation composition are discussed in Biodiversity and Vegetation sections of this chapter.

Timber Resources

Introduction

The Bighorn National Forest contains valuable timber resources. They are important for providing habitat for plants and animals and important to the people who use or are employed in the wood products industry. These products include construction lumber, fuelwood, transplants and Christmas trees, posts and poles, and wood for carving. Primary species include lodgepole pine in the intermediate elevations, spruce and fir at the higher elevations, mixed conifer of ponderosa pine, Douglas-fir and limber pine at the lower elevation, small clones of aspen, and cottonwoods found along the lower riparian zones.

Legal and Administrative Framework

The Forest and Rangeland Renewable Resources Planning Act of 1974, as amended by The National Forest Management Act of 1976 – these acts set forth the requirements for Land and Resource Management Plans for the National Forest System. 36 CFR 219 regulations require the Forest Service to identify areas suitable and available for timber harvest and the allowable sale quantity (ASQ) from those lands. In addition, regulations require us to analyze the supply and demand for resource commodities.

The Multiple-Use Sustained Yield Act of 1960 – “It is the policy of the Congress that the national forests are established and shall be administered for outdoor recreation, range, timber, watershed and wildlife and fish purposes...The Secretary of Agriculture is authorized and directed to develop and administer the renewable surface resources of the National Forests for multiple-use and sustained yield of several products and services obtained there from...the achievement and maintenance in perpetuity of a high-level annual or regular periodic output of the various renewable resources of the national forests without impairment of the productivity of the land.”

Organic Administration Act of 1897- Forests are established “to improve and protect the forest within the boundaries, or for the purpose of securing favorable conditions of water flows, and to furnish a continuous supply of timber for the use and necessities of citizens of the United States.”

AFFECTED ENVIRONMENT

Timber Production

Historical documentation shows that specific areas of the Forest were used for harvesting wood products. The history of cutting on what is now the Bighorn National Forest dates

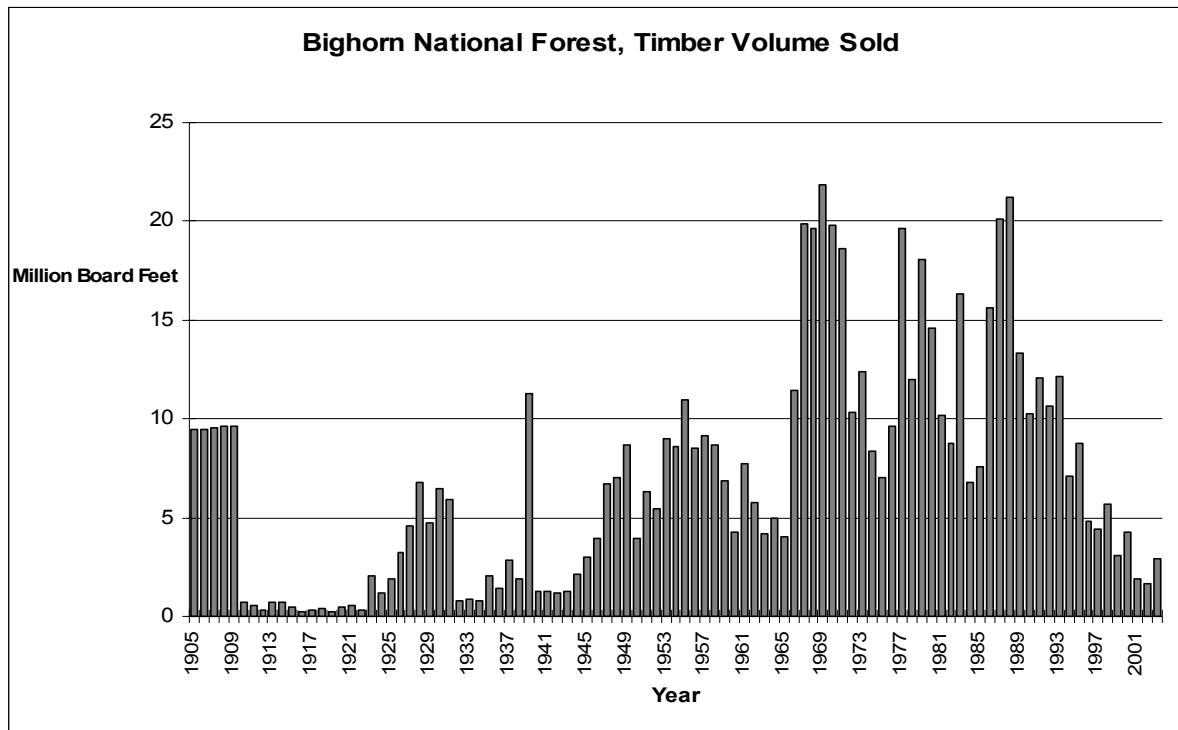
back to the late 1870s. One of the earliest government uses of the forests were for timber reserves. These wooded areas were set aside by the federal government to provide fuel and building materials for government installations, such as Fort Phil Kearny near Story, Fort Mackenzie near Sheridan and Fort McKinney near Buffalo. The most extensive early lumber operations within the present Forest occurred during the construction of the railroad east of the Forest. According to Murray, in 1905, one of the largest timber sales occurred when the McShane Timber Company bid on 50 million board feet of lodgepole pine (Murray 1980). By 1916 the railroad construction had moved on and the harvest of timber levels fell. Records from reports from 1905 to 2002 indicate approximately 7 million board feet (MMBF) was removed annually from the Forest. Annual harvest volumes ranged from less than 1 MMBF to 22 MMBF.

The highest volumes occurred during the late 1960s, when a stud mill was established in Sheridan. Many National Forests experienced similar cycles in harvesting as national events such as World Wars and economic ups and downs influenced the demands of the economy.

In 1975, a Timber Management Plan was approved for the Bighorn National Forest. This plan identified the timber management planning base acres, and established an “expected yield of wood products... [of] 66.0 M cunits including 21.6 million board feet of sawtimber.” This level of harvest was not met over the planning period, presumably due to conflicts with budgets and other resource objectives.

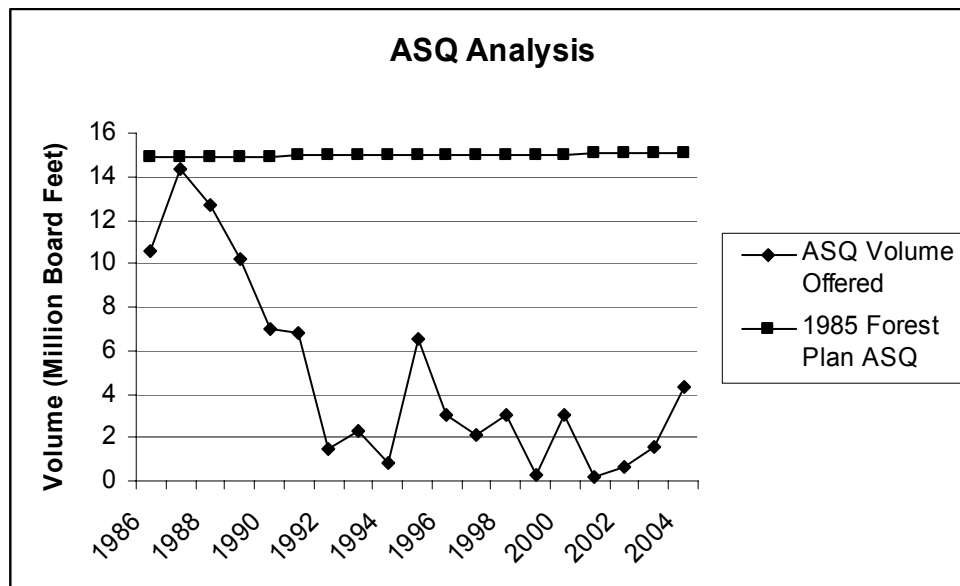
In 1985, the Land and Resource Management Plan (1985 Plan) for the Bighorn National Forest was implemented. The 1985 Plan identified lands suitable for timber production, and established an Allowable Sale Quantity (ASQ) of 38,600 CCF/yr (Cunits or 100 cubic feet) or about 14.9 MMBF/yr. Actual sale offerings since the 1985 Plan was implemented have decreased steadily. It was noted in forest plan monitoring that there were inconsistencies between the 1985 Plan standards and guidelines and outputs, i.e., ASQ sale offerings. The reduction in volume offered is due to a variety of factors including these 1985 Plan inconsistencies, appeals, and litigation of projects, as well as funding and staffing needs on the Forest.

Figure 3-2. Historic timber harvest volume.



The following figure shows the volume offered between 1986 and 2004, for conifer sawtimber only. The average annual ASQ volume sold during that period was 1,140 CCF or 4.8 MMBF.

Figure 3-3. Sawtimber volume sold since 1986.



The 1985 Plan total program offering includes “mortality volume” which has been interpreted as personal use fuelwood. Since the 1985 Plan was implemented the Forest has consistently exceeded the amount of “mortality”, selling 170% of the projected amount in the above planning period.

ASQ was again analyzed in 1993 as a part of a significant amendment process for ASQ that was never implemented. At the time of decision, it was thought that the Forest would start plan revision in a couple of years, and the decision was deferred until that time. For numerous reasons, the couple of years turned out to be longer than anticipated. The ASQ FEIS alternative ASQ amounts ranged from 3,700 to 65,700 CCF/year or approximately equivalent to 1.05 to 14.95 MMBF/year. The alternative that utilized 1985 standards and guidelines yielded 11,200 CCF/year (approximately equivalent to 4.39 MMBF/yr).

Timber Suitability

The Forest has determined the amount of forested land available, capable and suitable for timber production, per 36 CFR 219.14. The Bighorn National Forest has completed suitability analysis three times prior to this revision: once for the 1975 Timber Management Plan and again for the 1985 Plan.

Litigation in 1991 directed the Forest to calculate and amend the suited acres the third time. The 1991 analysis resulted in a net decrease of approximately 5,000 suited acres.

Suited acres were again analyzed in 1993 as a part of a significant amendment process for ASQ that was never implemented. This analysis yielded a net increase in the tentatively suited acres of less than 10,000 acres. The analysis work done for the 1993 ASQ amendment was not implemented but is sometimes shown for reference.

At the time of this revision, the current or 1991 plan amendment has identified 351,916 acres of tentatively suitable for timber production, of which 262,062 acres of the Forest were determined to be suitable, available, and scheduled for timber harvest. The results of the analysis for this document are discussed later in this chapter. Appendix B of the FEIS describes the process to determine lands tentatively suited for timber production. Additionally, each alternative, through management area designation, filters the tentatively suited lands to those suited for timber production.

Silvicultural System

The acres treated by commercial timber harvest from 1986 to 2001 include 1.78% of the forested lands. Acres treated with non-commercial thinning and reforestation includes 1.76% of the forested acres, but primarily includes previous commercially harvested lands.

There are two basic types of silvicultural methods: intermediate harvests and regeneration harvests. Intermediate harvests are any manipulations in a stand that occur between two harvest periods. Intermediate harvests ensure the desired composition, stem quality, spacing, and growth performance in a stand (Daniel, 1979). On the Bighorn National Forest, this

includes both commercial and non-commercial harvests, such as thinning, release, and weeding.

A regeneration harvest has a primary objective to remove trees so that regeneration occurs in a predictable period of time. There are several regeneration harvest methods including even-aged clearcutting and shelterwood and uneven-aged selection.

Even-aged Regeneration

The ages of the main canopy trees in managed even-aged stands do not differ more than 20%. Even-aged harvest methods on the Bighorn National Forest include clearcutting and shelterwood. Stands regenerate naturally following harvest, however to ensure timely response, artificial regeneration methods are sometimes used to supplant the natural regeneration following clearcut harvests.

Clearcutting is a harvest method that removes approximately 90 to 99% of all merchantable trees from the harvest site. The site is then prepared for the replacement stand. Since the harvested site is much more open, care must be taken to minimize erosion when preparing the seed bed. Reforestation is generally achieved through natural seeding with some artificial seeding required on larger units. Clearcutting is done once during the rotation (90 to 180 years) to accomplish regeneration.

The seed source for this method is the serotinous cones from harvested trees or neighboring timber stands. In most cases, this will be lodgepole pine. Because this method removes almost all the trees, the conditions after cutting and seedbed preparation also favor lodgepole pine. Some acres will require additional planting. Once established, tree growth for lodgepole pine is greatest under this method.

Clearcutting opens the natural canopy the most and has the least potential for blowdown of the even-aged systems. Because most of the canopy is removed, most of the tree diseases that could infect the regenerated stand are removed. This method requires fewer road miles per volume harvested than other methods. Clearcutting has the lowest cost per volume for Forest Service sale preparation and for the purchaser.

The National Forest Management Act of 1976 directs the Forest Service to use the clearcut harvest system only when "...it is determined to be the optimum method to meet the objectives and requirements of the relevant land management plan." Congress enacted NFMA in part to ensure that careful consideration and systematic analyses would be performed prior to harvest activities being implemented on a forested site.

Clearcutting can be an effective method of timber harvest in a variety of conditions. These may include control of pathogens such as dwarf mistletoe, regeneration of species that are shade-intolerant, or providing openings that are useful to some species of wildlife, as it emulates stand replacing wildfire. Determination of harvest methods must be analyzed individually to identify the characteristics that define the optimum harvest method to achieve the desired management objectives.

Clearcutting is primarily used for shade intolerant cover types. On the Forest, this includes lodgepole pine and aspen. The amount of clearcutting on the Forest has reduced from 93%

of total harvest acres during the 1960s to 26% for the 1990s. Clearcut harvesting on the Bighorn National Forest has been done at various scales over the decades, with clearcuts over 700 acres in the 1960s, small 3 to 10 acre clearcuts predominated the 1980s. Currently, the Forest has utilized clearcuts from a few acres to almost 200 acres designed to meet the resource needs of the individual project objectives.

Shelterwood harvest is a regeneration method that removes all merchantable trees from a site except those desired for seed and site amelioration. Normally between one third and one half of the stand is cut. Natural seeding regenerates the site. A stand of trees may be entered two or three times during a rotation to establish regeneration.

Shelterwood harvest requires more road miles per volume than clearcutting, but fewer than uneven aged regeneration. The remaining seed trees are the seed source for the next generation. Natural regeneration readily occurs with this method if harvest activities prepare the seedbed. The risk of blowdown is moderate; the risk of disease infection of the regenerated stand is high. Seed trees are removed after sufficient regeneration has taken place.

Shelterwood harvests are used in all cover types on the Bighorn National Forest, including lodgepole pine, spruce-fir and Douglas-fir.

Uneven-aged Regeneration

Uneven-aged stands are those with at least three distinct canopies of height and age (Smith, 1986). Regeneration is achieved using either individual tree selection or group selection methods. These harvests maintain much of the forest's natural character. They also open up the stand to establish regeneration, provide more growing space, and reduce competition for light, water, and nutrients.

Uneven-aged management generally affects larger areas. Fewer trees per acre are harvested, and generally less than 25% of the stand is removed. Re-entry into the stands, however, occurs more frequently (generally every 20 to 30 years). Uneven-aged regeneration relies on natural seeding to establish the new stand.

Individual tree selection - Individual tree selection (ITS) removes individual trees (or small groups) from the stand, and new trees grow in their place. This method works best with shade-tolerant species such as subalpine fir and Engelmann spruce. The blowdown risk is the least of the uneven-aged regeneration methods. Individual tree selection is the most costly method both in terms of Forest Service preparation and costs to the purchaser.

Group Selection - Group selection creates larger opening in the stand. The openings are not so large; however, that site protection from nearby trees is lost. The groups range in size from two acres to a few trees. Smaller groups favor more shade tolerant species such as spruce/fir mix, while larger openings will favor less shade tolerant species such as lodgepole pine. The perimeters of the groups are susceptible to blowdown. Group selection is less costly than individual tree selection, but more than other methods.

Other Treatments

Sanitation/Salvage – Sanitation cutting is the removal of insect-attacked or diseased trees in order to maintain the health of a stand. Salvage cutting is the removal of trees in order to obtain an economic gain before their value is lost from insects, disease, fire, or wind throw (Daniel, 1979).

Intermediate Harvests - These are generally called thinning. They include any harvest not designed to regenerate the stand of timber. This includes both pre-commercial and commercial thinning used to meet density level objectives.

Timber Stand Improvement - Timber Stand Improvement (TSI) is generally non-commercial or pre-commercial thinning of trees to meet density level objectives for stand health, growth, vigor, and other resource objectives such as wildlife hiding cover. Between 1986 and 2001, the Forest thinned 7,445 acres.

Reforestation – To ensure timely reforestation, artificial reforestation measures are sometimes used following certain timber harvest activities and natural catastrophes, such as wildfire.

Fuelwood - Currently, the Forest supplies fuelwood for both individual and commercial use. Fuelwood is obtained throughout much of the Forest and is available because of commercial vegetative treatments such as timber sales or natural mortality. Between 1986 and 2002, the Forest has sold an approximate average of 6,200 cords per year, 173% of what was projected for that period (2002 monitoring report).

The following table shows the acres of commercial harvest treatments since the 1960s. The total treatment acreage shown in this table is 61,506 acres, approximately 6% of the Forest. The actual acres receiving treatment is slightly smaller because some areas have been entered more than once to complete a multiple stage silvicultural treatment.

Table 3-182. Acres of past harvest treatments by decade between 1960s and 2004.

Silvicultural System	1960s	1970s	1980s	1990s	2000s
Clearcut	9,683	6,199	4,139	1,892	505
Shelterwood: Prep Cut	255	8,939	10,003	519	
Shelterwood: Seed Cut		519	3,935	1,428	895
Shelterwood: Overstory Removal	399	1,418	1,149	1,027	511
Shelterwood Seed Tree	30	386	40	54	
Selection		1,081	949	92	
Commercial Thin		900	2,105	186	

Silvicultural System	1960s	1970s	1980s	1990s	2000s
Sanitation/Salvage		710	3,474	2,321	279
Salvage of Blowdown ²³			581	4,500 ²⁴	
Pre-commercial Thin	2,537	1,811	11,776	1,109	2,552
Acres CC + SW + ST + S + S/S ²⁵	10,367	19,252	23,652	7,333	2,190

The following table displays the acres of harvest activity by silvicultural system that has occurred on the Forest since the 1985 Plan was implemented. Only 38% of the projected harvest acres was accomplished between 1986 and 2004. This is due to a variety of factors, including inconsistencies between projected harvests and 1985 Plan standards and guidelines, appeals and litigation, and budget constraints.

Table 3-183. Comparison of 1985 planned and actual harvest activity by silvicultural system 1986-2004.

Silvicultural System	Projected from 1985 Plan 1986-2004	Actual Acres 1986-2004
Clearcut	20,789	3,757
Shelterwood	12,034	6,265
Uneven-aged Selection	1,951	151
Commercial Thinning	None	54
Catastrophic Salvage	None	2,798
Other	None	118
Total	34,774	13,143

Source: Bighorn National Forest 2004 Monitoring Report

Reforestation

Reforestation is the re-establishment of forest cover either naturally (by natural seeding, coppice, or root suckers) or artificially (by direct seeding or planting) (Helms, 1998). The implementing regulations for the National Forest Management Act (NFMA) state:

“When trees are cut to achieve timber production objectives, the cutting shall be made in such a way as to assure that the technology and knowledge exists to adequately restock the lands within 5 years after final harvest. Research and experience shall be the basis for determining whether the harvest and regeneration practices planned can be expected to result in adequate restocking.” Further, “Five years after final harvest

²³ Several blowdown events, totaling several hundred acres, are not included in this database: Ranger Creek, Shell Creek, and Willett Creek.

²⁴ The 1991 Tongue Blowdown affected approximately 1,500 acres over a 6-mile-long area, and the 1993 blowdown affected an estimated 3,000 acres across the Forest. The most concentrated area was in the Little Bighorn River geographic area.

²⁵ CC = Clearcut, SW = Shelterwood, ST = Seed Tree, S = Selection, S/S = Sanitation/Salvage. These were summed to portray the amount of sawlog harvest that has occurred.

means five years after clearcutting, five years after overstory removal cut in seed tree cutting, or 5 years after selection cutting” (36 CFR 219.27)

Generally, harvests from suitable timber lands, described above, are used to achieve timber production objectives. Harvests from lands not suitable for timber production are not addressed above, however they are generally restocked except where permanent openings are created for wildlife, habitat improvement, vistas, recreation uses and similar practices (36 CFR 219.27). Natural disturbances, such as wildfire or blowdown may also create a reforestation need; however decisions to artificially reforest these areas are made on a site-specific basis. The Bighorn National Forest relies primarily on natural regeneration. Final harvest cuts on the Forest are generally successful utilizing natural regeneration following harvest. Where regeneration is not expected to occur naturally, planting has been the preferred method for artificial regeneration. Between 1986 and 2004, the Forest has planted a total of 4,238 acres.

Timber Supply and Demand

Timber markets have changed dramatically in recent years, and especially since the Forest Plan was first approved. This is true at all scales -- international, national, regional, and local. Recent documentation of timber markets in Wyoming have been produced by a variety of sources and authors. One particularly helpful report is *Wyoming Timber Market Analysis: The New Western Timber Economy*, prepared by Dr. Douglas Rideout and Dr. Hayley Hesseln in 2000. Since data were collected for that study in 1999, additional changes to the industry have occurred. More than a dozen new sources have been consulted since the DEIS was released. These reports, and public comment on the DEIS, provide the basis for this section.

In decades past, each National Forest typically had timber purchasers that were locally situated. Timber was rarely sold to purchasers located beyond a few hours drive from the Forest. These mills were very dependent upon timber coming from one or two national forests. Competition was limited to a few firms within this circle.

Today, timber purchasers are often regional firms that reach out 500 miles for timber that can come from federal, state, and private timberlands. Trends favor corporate ownership that can invest large sums to achieve very efficient mills using modern technologies. Lumber is then shipped to other parts of the United States, sometimes under exclusive contracts with wholesalers and retailers. This “new timber economy” in the Western U.S. is the product of many market forces, including industry consolidation, international trade agreements, reduced timber supplies from national forests, and generally smaller logs.

Over the last 10 years, purchasers of Bighorn National Forest timber have been primarily Wyoming Sawmills Inc. with a mill in Sheridan WY, Cody Lumber out of Cody WY, and R-Y Timber Inc. for their mill in Livingston, MT. Historically, Wyoming Sawmills Inc. has dominated timber activity on the Bighorn National Forest. In the last five years, however, a shift has taken place. R-Y Timber Inc. has become particularly active on the Forest, becoming the leading processor of Bighorn National Forest sawtimber. The influence of Montana mills on the Forest has also increased through L&L Lumber in

Buffalo, WY. L&L Lumber recently harvested Bighorn National Forest timber, then transported logs, by rail, to mills in western Montana. Changes such as these underscore the fluid nature of today's timber industry throughout the West. The estimated one-shift capacity of sawmills processing Bighorn National Forest timber is summarized in the following table.

Table 3-184. Estimated annual capacity and production for mills processing Bighorn National Forest timber (million board feet, log scale)

Geographic Area	One-shift Capacity	Annual Production
4-county Area	30	26
All Wyoming	35	29
Wyoming and Montana	55	70

The larger mills processing Bighorn National Forest timber produce studs and dimensional lumber. Numerous small firms produce a wide variety of products, including pallets, rough lumber, pellets, and posts and poles. The collective capacity of small firms is estimated to be less than 6 MMBF annually.

Wyoming Sawmills Inc. has developed a new structural strand lumber product, and desires to build a pilot plant in Sheridan. This new product does not require additional timber volume, but is fabricated from the residues of their current production. Because industry capacity and production estimates provided here are expressed in volume input, the estimates do not change when considering the proposed plant. The new plant would greatly improve the utilization of volumes harvested by Wyoming Sawmills Inc.

Timber supplies have changed dramatically since the forest plan was approved nearly twenty years ago. The National Forest System was the primary supplier of sawtimber for Wyoming mills for decades. Changing public values and policies, constrained budgets, and legal challenges have resulted in significant reductions of timber harvest on public lands. Timber industry responded by significantly increasing timber harvest on private, state, and tribal lands. Today private, state, and tribal lands provide about 90% of all timber supplies for mills that process Bighorn timber. The Bighorn National Forest provides about 6 percent of total supplies, and other national forests provide about 4 percent. It is generally recognized that today's timber volumes from private land are not sustainable in the long run. Wyoming's private timber supplies are often associated with multi-function ranches and affected by the price of timber relative to other ranch products and services such as the price of beef. Consequently, the future demand for and supply of timber from the Bighorn National Forest cannot be characterized by a simple projection of historic trends. Anticipated harvest and processing levels are discussed later in the Environmental Consequences portion of this section.

Table 3-185. Sawtimber volume sold and harvested, 1986-2004 (million board feet).

Year	Sold	Harvested
1986	1.7	10.3
1987	9.4	15.5
1988	19.0	16.9
1989	10.4	10.5
1990	2.1	7.4
1991	0.0	8.8
1992	4.3	11.5
1993	2.2	9.4
1994	0.8	4.0
1995	4.8	4.0
1996	0.8	4.5
1997	3.6	2.5
1998	0.0	1.6
1999	2.9	1.6
2000	2.8	1.3
2001	0.1	1.9
2002	0.2	0.4
2003	1.4	0.0
2004	3.6	0.9

Anticipated Harvest and Processing

As a ceiling on timber sold from suitable timber lands, allowable sale quantity (ASQ) has not been a reliable predictor of actual harvest levels. Annual budgets, project appeals, litigation, market conditions, natural disasters, and changes in national policies affecting resource management all have combined historically to reduce timber harvest on the Bighorn National Forest. Some factors tend to reduce harvest levels, while others increase the levels. Sawtimber typically accounts for the largest share of total ASQ volume and is the portion of greatest importance to local mills.

Estimating sawtimber volume harvested and processed locally during the first decade of the plan must consider a variety of factors – some regarding mill capacities and activity in the Bighorn timber market, and others regarding sources of timber supply. To account for these variables, several scenarios were developed.

The following table shows two processing capacity scenarios for Wyoming mills that have harvested and processed Bighorn National Forest timber over the last decade (1995-2004).

The Low scenario estimates the one-shift capacity of these mills, and the High scenario estimates their two-shift capacity.

Table 3-186. Capacity scenarios for Wyoming sawmills historically processing Bighorn National Forest timber.

Capacity Scenario	Number of Shifts at All Local Mills	Estimated Annual Volume (MMBF, log scale)
Low	1	35
High	2	70

As stated in the Timber Demand and Supply subsection above, sawmills based in Montana have become increasingly active on the Bighorn National Forest. The impact of Revised Plan alternatives on Wyoming sawmills must consider the activity of mills in Montana. As shown in the following table, the activity of Montana mills has changed rapidly. A look back over 5 years reveals a larger presence of R-Y Timber Inc on the Bighorn than looking back over 10 years. It is uncertain whether this trend will continue, yet it is likely that R-Y Timber Inc will remain a player in the market over the next decade. The table below also shows the assumptions made for this analysis regarding future market share by mill for Bighorn timber.

Table 3-187. Historic and projected sawtimber shares by mill for Bighorn National Forest timber.

Mill	10-year average (1995-2004)	5-year average (2000-2004)	Assumed for FEIS
Wyoming Sawmills	75%	26%	50%
R-Y Timber	15%	47%	30%
Cody Lumber	8%	19%	12%
L&L Sawmill	1%	5%	6%
Highline Enterprises	1%	3%	2%

All sawtimber sources have been considered in this analysis. It is generally agreed among forestry professionals that timber supplies from private lands cannot be sustained at levels seen over the last decade (1995-2004). To account for this expectation, it was assumed that supplies from these lands would drop about 10% by 2010 from the historic share these lands have provided to Bighorn-related mills. The reduction put timber supplies from state, private, tribal and other lands at 75% of total production levels over the past decade.

Sawtimber supplies from other National Forests, such as the Black Hills, Shoshone, and Custer, were held steady at their historic average. Sawtimber from the Bighorn National Forest was examined at two levels: 1) volumes that can be supported by experienced budget levels and 2) full ASQ. Experienced budget levels provide a realistic limiting constraint on future timber program volume. In the absence of budgetary limitations, full ASQ volumes could be offered and harvested. The following two tables show estimated

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levels of production by supply source for Wyoming mills without activity by Montana mills. Wyoming mills include all mills identified previously, except R-Y Timber, Inc. Without competition from Montana, these volumes represent the highest potential levels of Bighorn timber supplies for Wyoming mills.

Table 3-188. Projected Wyoming mill sawtimber supplies in 2010 **with** Bighorn National Forest budget constraints and **no activity** by Montana mills (MMBF).

	Alternative						
	Current	E	D-DEIS	D-FEIS	A	B	C
Bighorn National Forest	1.8	8.6	6.5	6.0	5.9	4.4	2.8
State/Private/ Other	25.1	22.0	22.0	22.0	22.0	22.0	22.0
Other National Forests	2.3	2.3	2.3	2.3	2.3	2.3	2.3
Subtotal Supply	29.2	32.9	30.8	30.3	30.2	28.7	27.1
One-shift Capacity	35.0	35.0	35.0	35.0	35.0	35.0	35.0

Table 3-189. Projected Wyoming mill sawtimber supplies in 2010 **without** budget constraints and **no activity** by Montana mills (MMBF).

	Alternative						
	Current	E	A	D-DEIS	D-FEIS	B	C
Bighorn National Forest	1.8	20.4	16.2	13.4	12.9	9.6	4.6
State/Private/ Other	25.1	22.0	22.0	22.0	22.0	22.0	22.0
Other National Forests	2.3	2.3	2.3	2.3	2.3	2.3	2.3
Subtotal Supply	29.2	44.7	40.5	37.7	37.2	33.9	28.9
One-shift Capacity	35.0	35.0	35.0	35.0	35.0	35.0	35.0

The activity of Montana mills on the Bighorn is very likely to continue, and their effective competition will affect supply sources for Wyoming mills. Should the Montana mills continue their activity on the Forest, supply sources for Wyoming mills are estimated as shown in the following two tables.

Table 3-190. Projected Wyoming mill sawtimber supplies in 2010 **with** Bighorn National Forest budget constraints and **activity** by Montana mills (MMBF).

	Alternatives						
	Current	A	B	C	D-DEIS	D-FEIS	E
State/Private/ Other	25.1	22.0	22.0	22.0	22.0	22.0	22.0
Bighorn National Forest	1.8	3.8	2.8	1.8	4.1	3.8	5.5
Other National Forests	2.3	2.3	2.3	2.3	2.3	2.3	2.3
Subtotal Supply	29.2	28.1	27.1	26.1	28.4	28.1	29.8
One-shift Capacity	35.0	35.0	35.0	35.0	35.0	35.0	35.0

Table 3-191. Projected Wyoming mill sawtimber supplies in 2010 **without** Bighorn National Forest budget constraints and with **activity** by Montana mills (MMBF).

	Alternatives						
	Current	E	A	D-DEIS	D-FEIS	B	C
Bighorn National Forest	1.8	13.1	10.4	8.6	8.2	6.2	3.0
State/Private/ Other	25.1	22.0	22.0	22.0	22.0	22.0	22.0
Other National Forests	2.3	2.3	2.3	2.3	2.3	2.3	2.3
Subtotal Supply	29.2	37.4	34.7	32.9	32.5	30.5	27.3
One-shift Capacity	35.0	35.0	35.0	35.0	35.0	35.0	35.0

The one-shift capacity line in each of the tables above represents the one-shift capacity of Wyoming mills historically harvesting and processing timber on the Bighorn National Forest. At the highest levels of Bighorn timber, which are very optimistic for Wyoming mills in terms of both agency budgets and no participation by Montana sawmills, one-shift capacities are slightly exceeded. Under these optimistic conditions, Bighorn timber is not likely to prompt two-shift operations at Wyoming mills. Conversely, under the most pessimistic conditions, it appears that mill production would drop by about 10%. Alternatives A, D-DEIS, and D-FEIS show moderating effects that offer mills the opportunity to maintain historic operation levels.

The analysis above attempts to provide reasonable estimates of industry impacts to Wyoming. The market activity of any given mill cannot be estimated. This is true for Wyoming Sawmills Inc, R-Y Timber Inc, and Cody Lumber. It is also true for potential market players, such as the re-opening of the L&L Lumber mill in Buffalo or participation

by mills that have historically operated only in the Black Hills. Current Wyoming mills have survived challenging market conditions over the past decade, and this analysis assumes these mills will continue to operate.

Sawtimber is not the only timber product that is harvested from forest lands. Products-other-than logs (POL), which include posts and poles, generally have low processing requirements. POL is typically generated with sawtimber volume, and therefore varies according to the supply scenarios discussed above. Additional POL volume can be generated from fuel and other resource treatments. All POL would be processed by firms with the Bighorn National Forest area. Anticipated POL and firewood volumes are displayed in the following table. POL harvest would be constrained by forest budgets, but not firewood.

Table 3-192. Products-other-than-logs and firewood harvest in 2010 (MMBF)

	Alt. A	Alt. E	Alt. D-FEIS	Alt. D-DEIS	Alt. B	Alt. C
POL	0.8	0.8	0.6	0.5	0.3	0.2
Firewood	1.5	1.5	1.5	1.3	1.0	1.0

Total Sale Program Quantity (TSPQ) includes all the volume anticipated to be offered from the Forest given experienced budget levels for timber sale offerings from lands suitable for timber production that contributed towards ASQ, and from Other Vegetation Management (OVM) on unsuited lands. Total sale program quantity includes volume from sawtimber, Products Other than Logs, personal use firewood, post and poles from all sales and permits. The ASQ portion is calculated based on experienced budget levels. The OVM portion is based on estimates of anticipated acres of treatment. For a detailed discussion of TSPQ, see Appendix B.

Table 3-193. Average annual total sale program quantity for first decade (MMBF).

Harvest	Alt. E	Alt. A	Alt. D-DEIS	Alt. D-FEIS	Alt. B	Alt. C
Experienced Budget	12.4	9.4	9.1	8.8	6.2	4.1
Full ASQ	24.3	19.8	16.0	15.7	11.4	5.9

Size Class Distribution

The following table displays the size class distribution for the primary commercial timber species on the 2005 tentatively suited lands (347,519 acres). Further description of how these lands are identified is found later in the chapter and in FEIS Appendix B.

The size classes reflect the predominant size of trees in that site or stand of the forest. Size classes are:

- ◆ E = Established size class for trees from 0 to 0.9 inches in diameter at breast height (dbh)
- ◆ S = Small size class for trees from 1.0 to 4.9 inches (dbh)
- ◆ M = Medium size class for trees from 4.9 to 8.9 inches (dbh)
- ◆ L = Large size class for trees from 9.0 to 15.9 inches in (dbh)
- ◆ V = Very Large size class for trees greater than 16.0 inches (dbh)

As shown on the table below there is currently a large portion of tentatively suitable acres in the medium size classes. It should be noted that lodgepole pine rarely attains the very large diameter class due to species characteristics. From a timber production standpoint, a more even distribution of size classes is desirable to promote even flows of better quality timber, and to reduce the risk from insect and disease outbreaks generally associated with older trees.

Table 3-194. Age and size class distribution of tentatively suited lands on the Bighorn National Forest.

Coverture	Non-stocked	Established	Small	Medium	Large	Very Large
Lodgepole pine	3%	3%	13%	58%	25%	1%
Spruce-fir	4%	1%	5%	44%	45%	5%
Douglas-fir	0%	0%	7%	49%	41%	2%
Total	3%	2%	10%	53%	31%	2%

ENVIRONMENTAL CONSEQUENCES

General Effects

Suitability

Identification of lands suitable for timber production is one of the key decisions made in a forest plan. The process to determine lands suitable for timber production is found in 36 CFR 219.14, and FSH 2409.13. The process is described in detail in FEIS Appendix B.

The acres identified as tentatively suitable for timber production are common to all alternatives based on physical characteristics of the land as identified using current inventory and data layers in a GIS format. These factors include various physical and administrative factors such as slopes, soil characteristics, low productivity, administrative withdrawals (wilderness), and site-specific analysis where applicable.

Lands identified as suitable for timber production varies by alternative and are based on management area prescriptions, multiple use objectives, and economic efficiency.

Only Management Areas 5.11, 5.12, 5.13, 5.4, and 5.5 contain suited lands, available for timber production objectives. The total lands suitable for timber production are displayed in the following table.

Alternative E has the highest level of suitable acres followed by A and then Alternatives D-FEIS, D-DEIS, B, and C respectively.

Table 3-195. Tentatively suited acres and suited acres by alternative.

	Alt. E	Alt. A	Alt. D-FEIS	Alt D-DEIS	Alt. B	Alt. C
Tentatively Suited for timber production and common to all alternatives	347,519	347,519	347,519	347,519	347,519	347,519
Suitable for timber production	307,901	262,359	185,277	175,070	117,756	57,323

Source: GIS Data

Suitable Species

Only lodgepole pine, Engelmann spruce, sub-alpine fir, and Douglas-fir are considered suited for timber production. Most of the suited acres are in lodgepole and spruce/fir cover types. The table below displays the suited lands by cover type.

Table 3-196. Suited land by covertime by alternative.

Percentage suited land	Alt. C	Alt. A	Alt. E	Alt. B	Alt. D-FEIS	Alt. D-DEIS
Lodgepole pine	69%	68%	68%	66%	65%	62%
Engelmann spruce/ subalpine fir	30%	26%	25%	29%	28%	30%
Douglas-fir	1%	7%	7%	4%	8%	8%

Source: GIS Data

Past Management Investments Forgone

The Forest has invested in managing forested lands for over 100 years. There are alternatives that remove previously managed lands from the suited land base, even though they have been harvested within the past 40 years. While some of these areas are not precluded from harvest, they no longer contribute to the Allowable Sale Quantity (see below), and are managed for other than timber production objectives. The relative ranking of alternatives that remove the most acres of previously harvested, and managed lands from the classification of suited for timber production are C, B, D-DEIS, D-DFEIS, A, and E.

Table 3-197. Past treatment acres not in suited land by alternative.

	Alt. C	Alt. B	Alt. D-DEIS	Alt. D-FEIS	Alt. A	Alt E
Acres of past treatment	67,001	38,141	29,301	28,073	12,850	5,301

Source: GIS Data

Suited and Scheduled Acres

Acres identified as suitable for timber production are processed using the *Woodstock*® timber modeling suite. Based on modeling constraints, and growth and yield information, the model schedules acres of appropriate harvest and uses these acres and yield tables for estimating harvest levels. Not all suited acres are scheduled for harvest in this planning horizon due to modeling constraints such as economic inefficiencies (areas where estimated road costs are too high in comparison to the value of the timber), stand not attaining culmination of mean annual increment, or constraints on type and intensity of harvests in areas of concern.

The following table displays suitable and scheduled acres by management prescription for each alternative. Alternatives schedule between 79 and 88% with Alternatives E, A, and D-FEIS having the lowest levels of suitable and scheduled timber and Alternatives B, C and D-DEIS the most.

Table 3-198. Total suitable and scheduled for the 150 year period modeled

	Alt. C	Alt. D-DEIS	Alt. B	Alt. A	Alt. D-FEIS	Alt. E
Percent of suited acres scheduled for harvest	88%	88%	87%	84%	83%	79%

Source: *Woodstock* © model

Allowable Sale Quantity (ASQ) and Total Sale Program Quantity (TSPQ)

“ASQ is the quantity of timber that may be sold from the area of suitable land covered by the forest plan for a time period specified by the plan. This quantity is usually expressed as a decadal value or on an annual basis as the average annual allowable sale quantity” (36 CFR 219.3). The ASQ is expressed in cubic feet, either hundred cubic feet (cunits or CCF), or thousand cubic feet (MCF). The Forest offers timber sale volume in cubic measurement units per current manual direction (FSM 2430.3). Because many people still relate to Scribner board feet, these equivalent values will be displayed where possible.

The ASQ for each alternative was formulated by considering the lands suitable for timber production for each alternative, other multiple-use objectives, and the management requirements in the NFMA regulations. A discussion of the analysis process and use of model constraints is found in FEIS Appendix B.

The ASQ is considered a ceiling for harvest from the lands suitable for timber production, and certain conditions may arise where standards and guidelines may limit what volume is

actually available during site-specific project implementation. Examples are water quality guidelines or wildlife and heritage resources protection measures. Where possible, the effect of these standards and guidelines has been taken into account in the calculation of the ASQ. See FEIS Appendix B for description of modeling analysis.

Products in the ASQ volume include traditional sawlogs and products other than logs (POL) harvested from lands identified as suited for timber production. POL includes posts, poles, chips, firewood, etc. POL does contribute towards the ASQ if removed from suited lands.

The table below displays the amount of ASQ for each alternative. ASQ is for the full implementation level regardless of budget constraints. In all alternatives, only Management Areas 5.11, 5.12, 5.13, 5.4, and 5.5 contain suited acres that contribute towards the ASQ. Alternatives E, A, D-DEIS, and D-FEIS provide the highest levels of ASQ respectively.

Table 3-199. Full ASQ.

	Alternative							
	1985 Plan*	No Action²⁶	E	A	D-DEIS	D-FEIS	B	C
Sawtimber ASQ CCF/year	38,000	9,000	36,250	30,372	24,064	23,467	15,946	7,982
POL ASQ CCF/year	1,000	---	6,326	5,236	3,712	3,716	2,135	657
Total ASQ CCF/year	39,000	9,000	42,577	35,608	27,775	27,183	18,080	8,639
Equivalent MMBF/year	15.1	4.5	14.9	12.5	10.0	9.8	6.6	3.4

* on page III-13

Source: Woodstock © reports

Other factors including budgets and changes in executive and congressional direction or natural events like wind, wildfires, insects, and disease could cause actual harvest levels to be different than projected. For example, the Forest has not been budgeted at levels to fully implement harvest levels projected in Alternatives A, E, D-DEIS and D-FEIS for over a decade. The experienced budget level limits the amount of timber that can be offered.

Timber harvest may be allowed on unsuited lands and in other management area prescriptions but only to meet the resource objectives compatible with that management area. Examples of such projects could include wildlife habitat improvement in Management Area 3.5 (plant and wildlife habitat management) or fuels treatments around a recreation site in Management Area 4.3 (dispersed recreation). Harvest in these areas is called Other Vegetation Management (OVM) and would not contribute towards the ASQ.

²⁶ Not an ASQ, but administrative direction from Regional Forester dated December 17, 1996.

Calculation of the OVM is based on a variety of assumptions that are described in FEIS Appendix B. Historically, other than salvage, OVM volume is fairly minor, as shown in the table below.

Total Sale Program Quantity (TSPQ) includes all the volume expected to be offered from the Forest given experienced budget levels for timber sale offerings from lands suitable for timber production that contributes towards ASQ and from OVM on unsuited lands. Total sale program quantity includes volume from sawtimber, Products Other than Logs (POL), personal use firewood, and post and poles from all sales and permits. The ASQ portion is calculated based on experienced budget levels. The OVM portion was based on estimates of anticipated acres of treatment prorated at the average volume per acre for suited lands. Personal use firewood is based on past recent history. The following table shows the anticipated average TSPQ for the first 10 years of plan implementation. No attempt was made to estimate the amount or type of salvage that may occur from natural events such as wildfire, blowdown, insects, and disease.

Table 3-200. Average TSPQ.

	Alternative					
	E	A	D-DEIS	D-FEIS	B	C
Experienced budget Sawtimber ASQ CCF/year	13,597	12,856	10,727	10,688	5,812	5,346
Experienced budget POL ASQ CCF/year	2,373	2,216	1,655	1,693	778	440
Experienced budget Total ASQ CCF/year	15,970	15,073	12,381	12,381	6,590	5,786
Experienced budget Equivalent MMBF/year	5.6	5.3	4.5	4.5	2.4	2.3
Firewood CCF/Year	3,000	2,900	2,500	3,000	2,000	2,000
Equivalent Firewood MMBF/year	1.5	1.5	1.3	1.5	1.0	1.0
OVM CCF/year	6,859	1,210	4,782	3,550	4,987	1,381
Equivalent OVM MMBF/year	2.4	0.4	1.7	1.3	1.8	0.6
TSPQ CCF/year	25,829	19,182	19,663	18,931	13,576	9,167
Equivalent TSP MMBF/year	9.5	7.2	7.5	7.3	5.2	3.9

Source: Woodstock © reports and other vegetation management assumptions.

Silvicultural Systems

A variety of silvicultural systems are available for the management of forest resources. The Woodstock © model produces an estimate of acreage treated by treatment types used in each alternative. The following table displays estimated treatment types by alternative. It should be noted that these are projection modeled estimates only. Site-specific project analyses will determine actual silvicultural prescriptions based on detailed, on-the-ground

conditions and project objectives. A variety of silvicultural tools are available in all alternatives, as described previously.

Table 3-201. Projected average annual harvest acres by cover and treatment types contributing to ASQ for decades 1-5.

Treatment Type	Alt. E	Alt. A	Alt. D-DEIS	Alt. D-FEIS	Alt. B	Alt. C
Lodgepole pine Clearcut	1,133	1,009	705	691	471	213
Lodgepole pine Shelterwood	0	0	0	0	0	0
Lodgepole pine Uneven-aged selection	787	595	346	348	200	115
Spruce-fir Shelterwood	116	54	148	201	129	44
Spruce-fir Uneven-aged selection	527	472	318	342	209	111
Douglas-fir Shelterwood	71	32	87	45	25	4
Douglas-fir Uneven-aged selection	136	132	115	74	31	11
Total Acres	2,772	2,294	1,719	1,700	1,066	498

Source: Woodstock © model reports

Even aged silvicultural methods modeled here include clearcuts and shelterwood harvests. Uneven-aged harvests include group selection cuts and individual tree selection cuts. Lodgepole pine was modeled using clearcut, shelterwood and group selection (at the stand level, these harvests are small pockets of even aged trees with all ages represented over the larger area). Spruce-fir and Douglas-fir were modeled with shelterwood and individual tree selection (clearcutting these cover types is not a standard practice for timber production objectives). All alternatives project a majority of even-aged management.

Based on the constraints, goals and objectives used on each alternatives suited acres, the model projected that Alternatives E and A would create the most early structural stages through clearcutting, followed by D-DEIS and D-FEIS. The amount of early habitat structural stages is one of the indicators to achieve the diversity goals for the Revised Plan.

Table 3-202. Projected early habitat structural stages

	Alt. A.	Alt. B	Alt. C	Alt. D-DEIS	Alt. D-FEIS	Alt. E
Suited acres after 10 Years	16%	19%	22%	16%	17%	15%
Suited acres after 50 years	8%	7%	7%	6%	6%	7%
Forested Acres after 10 years	8%	7%	7%	8%	8%	9%
Forested Acres after 50 years	2%	1%	1%	1%	1%	2%

Actual treatment plans will be based on site-specific goals and objectives and other site specific project level information. Previous forest plans have projected harvests, and actual harvest levels were disclosed in monitoring reports. The chart below shows how the average projected silvicultural methods from the timber model for the first 50 years compare with monitoring results. While the current timber model projects more uneven-aged management than accomplished in the past, partly in response to standards and guidelines, it remains to be seen how the actual silvicultural systems will compare to the model, and to past accomplishments. Continued monitoring will compare model projections and actual accomplishments.

Table 3-203. Monitored and projected silvicultural methods, decades 1-5

	Clearcut	Shelter-wood	Uneven- aged Selection	Other
1975 TM Plan	11%	82%	0%	7%
1985 Forest Plan	56%	39%	5%	0%
2004 Monitoring report	29%	48%	1%	22%
Alternative A	44%	4%	52%	
Alternative B	44%	14%	41%	
Alternative C	43%	10%	48%	
Alternative D-DEIS	41%	14%	45%	
Alternative D-FEIS	41%	14%	45%	
Alternative E	41%	7%	52%	

Non-commercial Treatments on Suited Lands

Each silvicultural regime modeled includes not only the commercial acres treated as described above, but also projects non-commercial treatments to achieve the vegetative

goals and commercial outputs. These non-commercial treatments are Timber Stand Improvements (TSI) including stand thinning, release, and weeding for stocking control; site preparation for natural or artificial regeneration such as broadcast burning; and planting both fill-in and full planting after harvests. The table below summarizes the average decadal acres of each of these treatments projected for the first five decades from the *Woodstock* © Model. It should be noted that the model does not include any of the current backlog of TSI or recent decisions for TSI, which total approximately 18,000 acres. Future timber stand improvements will be scheduled throughout the planning period, adding about 1,000 acres a year, as funding becomes available. Projections for thinning for fuels treatment are discussed in the vegetation section.

Table 3-204. Projected average annual non-commercial treatments decades 1-5.

Treatment Type	Alt E	Alt A	Alt D-DEIS	Alt D-FEIS	Alt B	Alt C
TSI	774	615	507	501	314	123
Site Preparation	1,048	921	670	659	447	199
Planting	634	547	405	400	269	119

Source: Woodstock © Model reports

Size Class Distribution

The following table displays the size class distribution for the primary commercial timber species on the 2005 suited lands for each alternative. Further description of how these lands are identified is found later in the chapter and in Appendix B.

The size classes reflect the predominant size of trees in that site or stand of the forest. Size classes are:

- ◆ E = Established size class for trees from 0 to 0.9 inches in diameter at breast height (dbh)
- ◆ S = Small size class for trees from 1.0 to 4.9 inches (dbh)
- ◆ M = Medium size class for trees from 4.9 to 8.9 inches (dbh)
- ◆ L = Large size class for trees from 9.0 to 15.9 inches in (dbh)
- ◆ V = Very Large size class for trees greater than 16.0 inches (dbh)

As shown on the table below there all the alternatives have a majority of their suited acres in the medium size class. From a timber production standpoint, a more even distribution of size classes is desirable to promote even flows of better quality timber, and to reduce the risk from insect and disease outbreaks generally associated with older trees. There are only slight differences between in alternatives, with alternatives B and C showing less medium and more small and large size classes.

Table 3-205. Age and size class distribution of suited commercial species on the Bighorn National Forest.

	Alternative					
	A	E	D FEIS	D DEIS	B	C
Non-stocked	3%	3%	3%	2%	3%	2%
Established	2%	2%	3%	3%	3%	4%
Small	11%	11%	11%	11%	13%	16%
Medium	53%	52%	50%	49%	44%	37%
Large	30%	30%	31%	32%	34%	37%
Very Large	2%	2%	2%	2%	2%	3%
Total	100%	100%	100%	100%	100%	100%

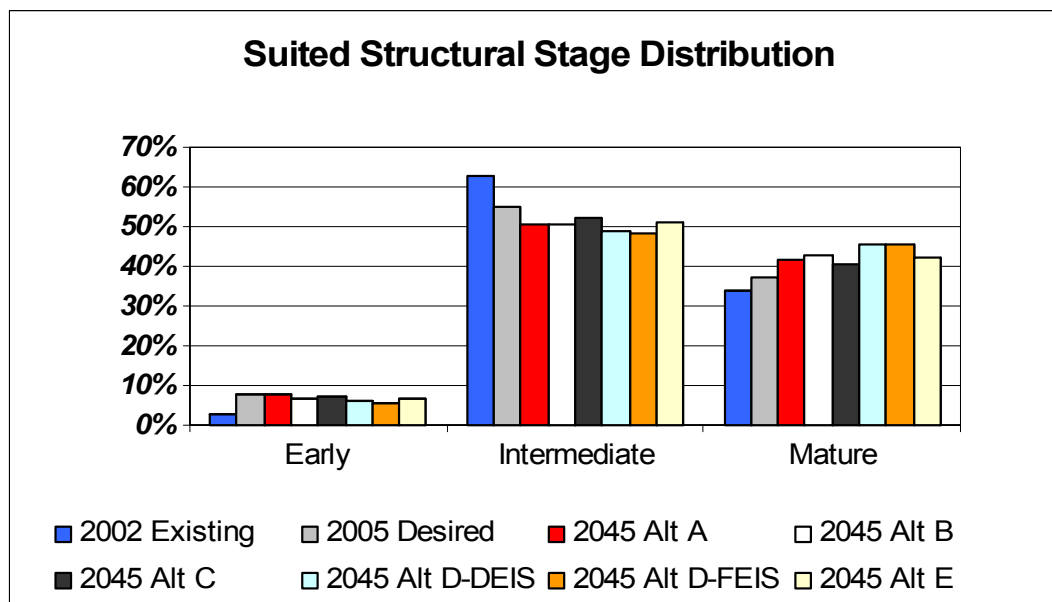
Structural Stage Distribution on Suited Lands

Size and age class distribution of timber species, on lands suitable for timber production, is a concern for maintaining healthy growing conditions and an even flow of goods and services. A condition with more timber in older age classes than can be harvested can lead to loss of volume expectations due to slow growth and risk of fire and insect and disease infestations.

Habitat structural stage is an indicator of both size, and density, which can be used as a surrogate for age class. The following figure summarizes the current distribution of structural stages on suitable lands for each alternative, the desirable distribution, and the estimated conditions after the fifth decade to show the trends in stand conditions by alternative. While not a direct correlation with age, size class provides a close approximation. The desired distribution comes from the Forest Plan Chapter 1.

Each alternative has a different total number of suited acres, as discussed above. Each alternative reacts differently to the models goals and constraints, based on management standards and guidelines, and how they are applied to the suited lands of each alternative. All alternatives affect the structural stage distribution of their respective suited acres about the same, with only slight differences between the alternatives in creation of early stages.

Figure 3-4. Structural stage distribution on suitable lands, by alternative.



Direct and Indirect Effects

Effects on Fire and Fuels Management: Under Alternatives C, and B, natural processes are emphasized and there is increased acceptance of wildfire. Although salvage operations are allowed in some of the natural processes areas, it would be done to meet the resource objectives of those management areas and is not considered a reliable source of additional wood fiber. Under Alternatives E, A, D-DEIS and D-FEIS, less of the forested area would be managed under natural processes respectively, and there would be more acres actively managed for protection from wildfire, with less acceptance of fire use in these management areas. Alternatives with more active management and more acres of land designated as suitable for timber production have increased opportunity to salvage burnt wood fiber than in Alternatives C and B.

Effects from Insect and Disease Management: Insects and disease can affect the production of timber by killing and damaging trees. Alternatives C and B emphasize natural processes and there is increased acceptance for insect and disease damage to the timber resource outside the suited lands. This could result in damaging or killing trees on a variety of scales, depending largely on factors such as populations, stand conditions, and natural events such as wind and climate. In these alternatives there would be large areas where natural processes dominate, including insects and disease populations. Because at epidemic levels, insects and disease are irrespective to administrative boundaries there would be increased risk of damage and death to adjacent lands actively managed from these natural processes areas. Although salvage operations are allowed in some of the natural processes areas, it would be done to meet the resource objectives of those

management areas and is not considered a reliable source of additional wood fiber. Under Alternatives E, A, D-DEIS and D-FEIS, less of the forested area would be managed under natural processes respectively and it is projected that there would be more active suppression and pretreatment of the actively managed areas. A large infestation could momentarily increase timber supplies through salvage sales, however future supply may decrease. Recent history is showing us that while management activities have an influence on insect and disease levels; climatic conditions are often the largest contributor to epidemics.

Effects from Lynx Amendment Standards and Guidelines: The Forest Service is in the process of amending Land and Resource Management Plans (LRMPs) for national forests in Wyoming through a separate NEPA process conducted at a multi-regional level to provide conservation and recovery of the Canada lynx, a threatened species. A draft of the amendment was released in 2004.

The proposed amendment establishes management direction that conserves and promotes recovery of the Canada lynx. These standards and guidelines have the potential to affect timber management operations. These standards and guidelines are attached to the forestwide list. Lynx standards and guidelines would only be applied if lynx are known to occupy habitat on the Forest, which they currently do not. The Canada lynx Conservation Measures identified in the Lynx Conservation Assessment and Strategy (Ruediger et al. 2000) were included in the *Woodstock* © timber model.

Given the relatively small amount of lands suitable for timber production under all alternatives, the restrictions on harvesting in lynx habitat are not thought to significantly affect forestwide timber outputs. The lynx vegetation standard that requires inventory before any salvage of portions of blowdown and insect infestation may increase the size of insect infestations due to the delay related to the required inventory. A potential result could be the loss of trees and an increased fuel load.

The lynx vegetation standard that delays precommercial thinning within lynx habitat has the potential to reduce wildlife habitat, old growth conditions, and mature open stands. In addition, there may be more stagnated pole stands with lower wood fiber yields and increased risk for insect damage if stands are not treated. The lynx rangeland standard requiring protection of regeneration in natural or created openings could increase the regeneration success in these areas.

Cumulative Effects

The cumulative effects table at the beginning of this chapter includes the list of past, present, and reasonably foreseeable future activities that were considered with regard to cumulative effects to the special forest/rangeland resource. This planning period or the next 10 to 15 years are considered the time span for cumulative effects. The area of consideration for the cumulative effects analysis encompasses the Forest and the area in a 200-mile radius around it.

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Timber harvest in the cumulative effects analysis area includes U.S. Forest Service, BLM, tribal, private, and state lands. Estimates of harvest from these sources are listed below. This table also shows that the anticipated Bighorn sale program is a relatively small proportion of the total volume sold in the working circle. Federal, state, and tribal timber lands are by law managed on a sustainable basis. However, as harvest from national forests has fallen private lands have seen an increase, and it is not known how long they can sustain the current levels of harvest.

The Bighorn National Forest contribution to the volume offered in the working circle varies by alternative. Alternatives E and A offering the most, while B and C offer the least, with D-DEIS, and D-FEIS in the middle. This applies to both ASQ and TSPQ. No matter how much timber the Bighorn offers, demand for volume exceeds the supply.

Table 3-206. Estimated volume offered in cumulate effects analysis area per year for the next decade.

	Alternative					
	E	D-DEIS	A	D-FEIS	B	C
Bighorn National Forest TSPQ CCF/year	25,829	19,663	19,182	18,931	13,576	9,167
Equivalent TSPQ MMBF/year	9.5	7.5	7.2	7.3	5.2	3.9
Shoshone National Forest anticipated offer MMBF/year	4.5	4.5	4.5	4.5	4.5	4.5
Custer National Forest anticipated offer MMBF/year	3.5	3.5	3.5	3.5	3.5	3.5
BLM east of Bighorn NF anticipated offer MMBF/year	1.0	1.0	1.0	1.0	1.0	1.0
BLM west of Bighorn NF anticipated offer MMBF/year	0.5	0.5	0.5	0.5	0.5	0.5
Crow Reservation anticipated offer MMBF/year	4.8	4.8	4.8	4.8	4.8	4.8
Northern Cheyenne Reservation anticipated offer MMBF/year	6.0	6.0	6.0	6.0	6.0	6.0
State of Wyoming anticipated offer MMBF/year	1.0	1.0	1.0	1.0	1.0	1.0
Private lands anticipated offer MMBF/year	Unknown					
Total anticipated offer MMBF/year	26.5	24.5	23.2	26.8	26.6	28.8

Source: Woodstock © reports and personal conversations.

Communities

Communities

Introduction

The human environment includes the biological and physical environment and people's relationship to it. The relationship between the Bighorn National Forest and the local lifestyles and economies is interdependent and complex. Year-round residents and nonresidents utilize Forest resources to make a living, find solace, and experience a good deal of their social life. Residents of the four-county Bighorn National Forest area have a close relationship with the "mountain." This section focuses primarily on the community-National Forest relationship. Affected counties for the purposes of this Environmental Impact Statement are Big Horn, Johnson, Sheridan, and Washakie Counties, Wyoming.

This affected environment section is a short summary of the social and economic assessments, which offer more detailed descriptions of each county's demographic and economic makeup, and of the relationships between the counties and the National Forest. These documents are on file at the Bighorn National Forest Supervisor's Office.

The Communities portion of the FEIS is separated into four subsections: *Demographics*, *Stakeholders*, *Economics*, and *Local Governments*.

Legal and Administrative Framework

The **National Environmental Policy Act (NEPA)** requires that consequences to the human environment be analyzed and disclosed. The extent to which these environmental factors are analyzed and discussed is related to the nature of public comments received during the public involvement process, from scoping through preparation of the DEIS.

The **National Forest Management Act** requires the examination of local economic impacts as well as economic cost-efficiency considerations when preparing or revising a forest plan.

Executive Order 12898 requires that planning alternatives be assessed to determine whether they would disproportionately affect minority and low-income populations. The concept is called "environmental justice."

The **Secure Rural Schools and Community Self-determination Act of 2000** specifies how states and counties will be compensated for impacts associated with visitors to National Forest System lands.

The **Payments in Lieu of Taxes Act of 1976** authorizes compensation to counties in lieu of property taxes that cannot be levied against federal lands within their jurisdiction.

Demographics

AFFECTED ENVIRONMENT

Geographic Location

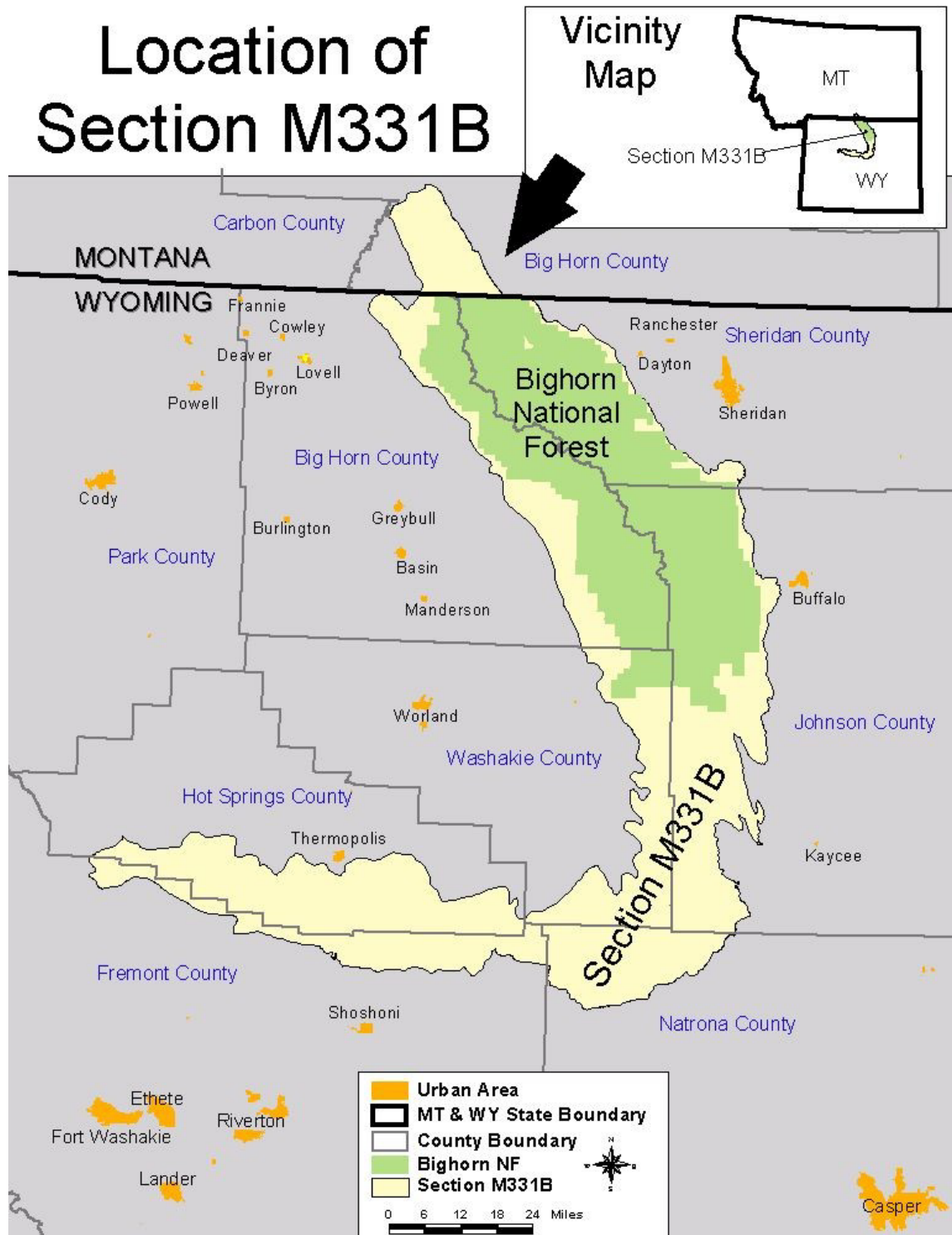
The following map shows the location of counties and selected communities surrounding the Forest. The Bighorn National Forest is located in north central Wyoming.

Population Patterns and Trends

The following table shows the county populations from 1890 to 2000. In contrast with most national trends, Big Horn and Washakie counties have had mixed population changes over time. Since 1950, both of these counties have seen periods of growth and decline but have been relatively stable in the long run.

Sheridan County had an increase in population in the 1980s, which was attributable to the ‘energy boom’ of that era. This boom ‘busted’ in the later half of the 1980s as energy prices declined and Big Horn Coal shut down production. The bust resulted in lower housing prices and a decline in the population. Sheridan’s population growth trend picked up again in the early to mid-1990s, which shows in the 2000 population estimate. This growth was largely attributable to a combination of factors. The Wyoming Housing Database Partnership data for Sheridan between 1999 and 2004 indicated that 36% of the new residents getting Wyoming driver’s licenses in Sheridan County moved to Wyoming for job-related reasons, 21% for quality of life considerations, 21% because of friends or relatives, 3% for starting or expanding a business, and 18% for other reasons. ‘Quality of life’ is a complex factor that can cut both ways. Some surveys have revealed that ‘quality of life’ was a problem in recruiting new employees to the area particularly due to a perceived lack of cultural amenities and shopping. Despite some limitations of the area, Sheridan has seen robust growth accompanied by large property value increases.

Map 3-3. Location map of the Bighorn National Forest and surrounding communities.



Johnson County, unlike the others, has experienced mostly steady growth over the years. Development of coalbed methane promises to accelerate county growth in the near future.

Table 3-207. Population of Bighorn National Forest counties, 1920-2004.

Year	Big Horn	Johnson	Sheridan	Washakie
1920	12,105	4,617	18,182	3,106
1930	11,222	4,816	16,875	4,109
1940	12,911	4,980	19,255	5,858
1950	13,176	4,707	20,185	7,252
1960	11,898	5,475	18,989	8,883
1970	12,202	5,587	17,852	7,569
1980	11,896	6,700	25,048	9,496
1990	10,525	6,145	23,562	8,388
2000	11,461	7,075	26,560	8,289
2004	11,416	7,657	27,163	7,939

Source: U.S. Census Bureau

Some of the smaller communities in the 4-county area, including Clearmont, Tensleep, and Manderson, have had significant populations declines over the past few decades, as shown in the following table. People in these communities are concerned about the viability of their schools, which are an important factor in the “identity” and independence of a community.

Table 3-208. Population for selected communities by county, 1960 to 2003.

County/City	2003	2000	1990	1980	1970	1960
Big Horn						
Basin	1,203	1,238	1,180	1,349	1,145	1,319
Burlington	250	250	184			
Byron	546	557	470	633	397	417
Cowley	571	560	477	455	366	459
Deaver	179	177	199	178	112	121
Frannie	208	209	148	138	139	171
Greybull	1,749	1,815	1,789	2,277	1,953	2,286
Lovell	2,283	2,281	2,131	2,447	2,371	2,451
Manderson	103	104	83	174	117	167
Johnson						
Buffalo	4,220	3,900	3,302	3,799	3,394	2,907
Kaycee	266	249	256	271	272	284
Sheridan						
Clearmont	117	115	119	191	141	154
Dayton	703	678	565	701	396	333

County/City	2003	2000	1990	1980	1970	1960
Ranchester	719	701	676	655	208	235
Sheridan	16,016	15,804	13,900	15,146	10,856	11,651
Washakie						
Ten Sleep	310	304	311	407	320	314
Worland	4,944	5,250	5,742	6,391	5,055	5,806

Source: U.S. Census Bureau

On the other hand, other communities have been showing growth trends. The Center for the American West has projected that areas around Sheridan and Buffalo are forecast to see “urban sprawl” over the next several decades as people move to the area and build homes and ranchettes in what previously had been agricultural/ranch land. Several impacts are felt by communities where housing development replaces agricultural lands. One such impact is the decrease in the amount of open space and low populations that current residents prize as part of their quality of life. Land conversion and development is further discussed in the Local Governments subsection of this chapter.

The following table shows that all counties are expected to be stable or grow in population over the next 25 years. Projections are important to many in the public and private section and are valued by the Forest Service as a basis for anticipating recreational. Several projections from Wyoming state sources were available, but the high scenario from the Wyoming Housing Partnership was ultimately selected. The Wyoming Business Council was instrumental in guiding this decision. Projections of population stability or growth are founded on the in-migration of households rather than the retention of young residents.

Table 3-209. Population projections by county from 2000 to 2020.

Year	Sheridan	Big Horn	Johnson	Washakie
2000	26,560	11,461	7,075	8,289
2005	27,808	11,294	7,680	7,905
2010	29,504	11,561	8,048	8,021
2015	31,214	11,922	8,417	8,217
2020	32,954	12,357	8,821	8,484

Source: Wyoming Housing Database Partnership, 2005

The aging of Wyoming’s population has been discussed in many forums recently. Census data show that the population of the 4-county area is old and is getting older. The following table shows that the median age of each county increased from 2.6 (Big Horn) to 5.5 (Johnson) years in the decade. This compares to a statewide median age increase of 3.3 years and a national median age increase over the decade of 2.4 years. The United States median age change from 1990 to 2000 was 32.9 years to 35.3 years.

The trend of an aging population is likely to continue into the future. According to Dr. Steven Maier, President of the Northern Wyoming Community College District, Wyoming is expected

to be the only state in the United States that will see a decline in the number of high school graduates over the next two decades. The loss of younger residents is attributed to fewer good paying, entry level jobs that would keep them in Wyoming. This is evidenced from increasing prominence of service sector jobs, as opposed to entry level professional and manufacturing sector jobs, which will be discussed in more detail in the Economic subsection. This is also evidenced by anecdotal information collected in Wyoming Rural Development Council sponsored community assessments in communities around the National Forest, where this is a commonly held sentiment by area residents.

Table 3-210. Median age by county, 1990 and 2000.

	1990	2000
Johnson	37.5	43.0
Sheridan	36.3	40.6
Big Horn	36.1	38.7
Washakie	34.6	39.4
Wyoming	32.1	36.2

Source: US Census Bureau

One of the implications of an aging population upon the Bighorn National Forest is likely to be different recreation demands. Activities such as driving for pleasure and the use of developed campgrounds are likely to increase, while the relative demand for more strenuous activities, such as mountain climbing or backpacking, are likely to decrease.

Environmental Justice

A specific consideration of equity and fairness in resource decision-making is encompassed in the concept of environmental justice and civil rights. As required by Executive Order 12898, all federal actions must consider potentially disproportionate effects on minority or low-income communities. Principles for considering environmental justice are outlined in Environmental Justice Guidance under the National Environmental Policy Act (Council on Environmental Quality 1997). Those principles are recognized and have been considered in this analysis.

The following table provides demographic statistics for identifying potential communities of concern. Washakie County has a higher percentage of Hispanic people than does the state of Wyoming as a whole. This reflects historic settlement patterns and the farming industry in the Big Horn basin.

Table 3-211. Percent of population by ethnicity for Wyoming and Bighorn area counties, 2000.

State/County	White	Hispanic	American Indian	Black	Other
Wyoming	85.5%	6.4%	3.0%	1%	4.1%
Big Horn	87.8%	6.2%	1.4%	<1%	4.4%
Johnson	94.8%	2.1%	1.5%	<1%	1.4%
Sheridan	93.4%	2.4%	1.9%	<1%	2.0%
Washakie	78.3%	11.5%	1.6%	<1%	8.3%

Source: U.S. Census Bureau

American Indians have a relationship with the land that started long before the Bighorn National Forest was established. Because of this relationship and their standing as a sovereign nation, seventeen tribes on the plan revision mailing list received scoping, meeting, and draft document availability notices. The Eastern Shoshone, Northern Arapaho, Northern Cheyenne, and Crow tribal councils were personally visited during the scoping period. District Rangers or the Planning Staff provided an overview of the planning process and an invitation to consult using any format, visits, or other communication methods they chose. Given the programmatic nature of forest plans, the tribal councils elected not to pursue additional meetings or consultation on the general revision topics.

However, additional consultation with the four tribes listed has occurred throughout the revision process at the annual Medicine Wheel Historic Preservation Plan (HPP) meetings. Focused primarily on the Medicine Wheel HPP area, consultation occurred on the management area boundary, Revised Plan direction, and on the eventual management area designator, 'MW'. Forest Service representatives to these meetings were the Forest Supervisor and the Medicine Wheel/Paintrock District Ranger.

Big Horn and Johnson counties had large decreases in the family poverty rates between 1990 and 2000, while Sheridan and Washakie counties had the highest percentage of families below the poverty level than the other counties (see following table).

Table 3-212. Percent of families below poverty level and total population, 1990-2000.

State/County	Poverty Level Rate			Population		
	1990	2000	% Change	1990	2000	% Change
Wyoming	11.9%	11.4%	-4.2%	453,588	493,782	8.9%
Big Horn	16.4%	14.1%	-14.0%	10,525	11,461	8.9%
Johnson	12.9%	10.1%	-21.7%	6,145	7,075	15.1%
Sheridan	10.4%	10.7%	2.9%	23,562	26,560	12.7%
Washakie	11.2%	14.1%	25.9%	8,388	8,289	-1.2%

Source: U.S. Census Bureau

Poverty level is the most common measure of households with low incomes. Recently, another measure was provided through a study of economic self-sufficiency in and for the state of Wyoming. Self-sufficiency was defined as "the income needed for a family of a certain composition in a given place to adequately meet their basic needs without public or private assistance." Wages needed to attain this income level varied by county and community around the state. Counties were grouped into five categories based on the income needed to achieve self-sufficiency. Johnson County was among those Wyoming counties requiring the lowest income – slightly less than \$20,000 annually for a single adult with one preschooler. Big Horn and Washakie Counties were in the next highest grouping, requiring slightly more than \$20,000 per year for the same household. Sheridan County was in the second highest income category, requiring \$22,000-\$23,000 annually. The highest income category is occupied by Teton County (Jackson Hole).

Human History, Customs, and Culture

Knowing the history and culture of an area can often provide valuable context for understanding communities and how current or future events may shape their lives. The following section is a brief historical and cultural profile of the planning area.

People have lived in the area for about as long as people have lived in North America. At the Colby site south of Worland, Dr. George Frison of the University of Wyoming found a Clovis point that indicates human habitation dating back about 10,000 years.

In the 1700s, several American Indian tribes, including the Crow, Shoshone, and Snakes, lived in the Powder River and Bighorn Basins. By 1812, the Crow were the dominant culture using the area (Murray, 1980). Within a few decades, the Powder River Basin had become part of the country dominated by the Sioux and Northern Cheyenne. Presently, several tribes, including the Crow, Northern Cheyenne, Arapaho, Shoshone and Sioux, use the Bighorn National Forest to gather tepee poles and other plants, to hold vision quests and other ceremonies, and to use the Medicine Wheel. Many spots on the National Forest are important to American Indian people, who consider their uses part of multiple use, but make a distinction between their uses and others. The difference is the spiritual dimension they assign to certain activities on National Forest System land.

The year 1802 brought the first European men of specific record to within close-up view of the Big Horn Mountains, and the first recorded crossing of the Bighorns came a decade later, when a party with the American Fur Company crossed over near Powder River Pass. While the fur trappers spent time traveling through the Big Horn Mountain country, "...there is not much indication of the kind of intensive trapping activity we find in some other mountain regions." (Murray, 1980)

Likewise, mining in the Big Horn Mountains itself was never an important activity. In his review of the Big Horn Mountains, N.H. Darton concluded that the mineral prospects proved disappointing, and there was little chance that the area would become important on account of its mineral resources (Darton, 1906). The most significant area of mining was near Bald Mountain, where about 2 years of gold-mining took place in the early 1890s.

Several major "recent" historical influences have had effects upon the resources of the Big Horn Mountains to this day. While many areas of the west were settled by Europeans as early as the 1840s and 1850s, with associated human impacts on the nearby resources, the Big Horn mountain area remained largely the domain of Americans Indians until after the Battle of Little Bighorn in 1876. Earlier attempted "civilization" of the eastern side of the Big Horn Mountains was successfully resisted by the Sioux and Northern Cheyenne people in 1867 when they forced the U.S. Army to abandon Fort Phil Kearney. The city of Sheridan, for example, was organized in 1882, and most of the Bighorn Basin communities were not organized until about 1900. Therefore, the impact of European man on the resources of the Big Horn Mountains was rather minimal until about 1880.

Numerous reservoirs were constructed in the Big Horns in the 1890s, and some of the communities, including Buffalo and Sheridan, get drinking water from streams originating in the Big Horns.

Minor logging operations for fuelwood and building materials had minor impacts along the fringes of the Big Horn Mountains. Logging for railroad ties was important in the Tongue and Clear Creek watersheds. The South Tongue River area was heavily tie-hacked between about 1893 and 1908. While there was some stream alteration for tie drives in portions of the Tongue River, a large tie-flume network was developed. Tie-hacking in the Clear Creek watershed above Buffalo did not begin until 1924 and lasted about a decade. Annual reports in the local papers listed tens of thousands of dollars of “stream improvements,” which were channel straightening and debris removal, activities which have been documented to have long-lasting effects (Young et al. 1994). One other lasting effect of the early tie-hacking was that tie hacking was largely a “high-grade” operation that left the dysgenic trees which is posited to have lasting genetic effects (Howe 1996).

The European economic activity that most influenced resources and the settlement patterns in the Big Horn Mountain area was livestock grazing. The first permanent settlers were associated with ranching activities. While the record is not totally clear on when livestock were first grazed in the mountains (Murray, 1980), it is clear that by the time the Bighorn Reserve was established in 1897 the number of livestock utilizing the summer range of the mountain was very large (Jack, 1900). Ecologically, this level of grazing had important impacts upon the resource, most of which have recovered over the past 100 years due to improved livestock management practices.

The grazing legacy of the settlement period has had several lasting effects. Despite decreases in the numbers of permitted livestock, the Bighorn National Forest remains a relatively heavily stocked National Forest, and the communities around the Big Horn Mountains have a “cowboy/western” identity that is used for economic purposes, such as tourism promotion, and helps to define a sense of place for the people living in the area.

ENVIRONMENTAL CONSEQUENCES

Direct and Indirect Effects

Population Patterns and Trends

Population patterns and trends in Bighorn area counties and communities as discussed above are not expected to be affected by the decisions of this forest plan revision. Stability or growth in numbers, as well as patterns of increasing median age, are products of demographic and economic forces much larger than the scope of management alternatives considered here. The price of energy products and the local availability of energy resources have long dictated the boom and bust cycles in northeast Wyoming. This has recently been noted in ‘coal bed methane’ activity, and subsequent population influx for

the past five years. The Bighorn National Forest has not had energy development, and such development over the next decade is unlikely (Crockett 2004).

Environmental Justice

Minorities, including the tribes discussed above, and those with incomes below poverty level should not see a disproportionate impact as a result of forest plan decisions. Impacts to the general population and communities as a whole are expected to be negligible or non-existent. There is no reason to anticipate that whatever impacts do occur generally will have a disproportionate impact to those specifically considered within the scope of environmental justice.

The National Survey of Recreation and the Environment (Cordell et al. 1997) provided the Forest Service with a profile of the individuals participating in various recreational activities on the National Forests in the Rocky Mountain Region (Montana, North Dakota, South Dakota, Nebraska, Kansas, Idaho, Utah, Nevada, Arizona, New Mexico, Colorado, and Wyoming). The survey revealed that rates of participation in recreational activities available on National Forest System lands are very similar between minority groups and Caucasians. Therefore, impacts from changes in recreation opportunities under any alternative should not have a disproportionate impact on any minority or low-income group.

Cumulative Effects

The cumulative effects for demographic and economic considerations are very inter-related and therefore best discussed together. Please see the cumulative effects subsection within the Economics discussion.

Stakeholders

AFFECTED ENVIRONMENT

As a national asset with a local setting, the Bighorn National Forest has stakeholders with a broad spectrum of interests and positions. To gain an understanding of similarities and differences among the stakeholders, studies of residents in the 4-county area around the Forest and a survey of the U.S. population were examined.

Social Assessment of the 4-County Area (SAFCA)

The University of Wyoming, under contract from the state of Wyoming, prepared a social assessment of the 4-county area immediately around the Bighorn National Forest. The assessment included a survey of residents to obtain an overview of their opinions, attitudes, and utilization of the forest. Surveys were mailed to over 2,400 randomly selected residents; 1,230

residents responded. The final report is available online at:
<http://www.fs.fed.us/r2/bighorn/projects/planrevision/forestwide/>

National Survey on Recreation and the Environment (NSRE)

The USDA Forest Service completed its Strategic Plan (2000 Revision) in October 2000. The goals and objectives included in the Strategic Plan were developed with input from the public, some of which was obtained through a telephone survey. The Results Act requires an agency to ask for the views and suggestions of anyone “potentially affected by or interested in” its Strategic Plan. The long-term goals and objectives of the Strategic Plan must therefore reflect not only the agency’s mission, but also the public’s views and beliefs for our country’s forests and grasslands. This report presents the results of a telephone survey in which randomly selected members of the American public were asked about their:

- ◆ Values with respect to public lands.
- ◆ Objectives for the management, use, and conservation of forests and grasslands.
- ◆ Beliefs about the role the USDA Forest Service should play in fulfilling those objectives.
- ◆ Attitudes about the job the USDA Forest Service has been doing in fulfilling their objectives.

The *Stakeholders* portion of this Communities section is based on 7,069 responses to the NSRE phone survey.

Members of the American public were asked about their values with respect to public lands, objectives for the management of public lands, beliefs about the role the agency should play in fulfilling those objectives, and attitudes about the job the agency has been doing.

Although the studies had different designs and presented results in different ways, their purposes were similar. The following section structures the results of the study so that they may be compared. The SAFCA, being focused solely on the Bighorn National Forest, contains results with more geographic and subject specificity than the NSRE. SAFCA results are presented in tabular form, while comparable NFSRE results are discussed in narrative. The table below shows resident preferences for “desired future conditions” they would like to see on the Bighorn National Forest.

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Table 3-213. Percent and rank order (in parentheses) of SAFCA respondents answering “Yes” to future desired conditions on the Bighorn National Forest.

Category/Desired Condition	Big Horn	Washakie	Johnson	Sheridan	Total
Preservation/Designation					
Set aside land for wilderness	12% (14)	13% (14)	21% (13)	27% (11)	21% (14)
Designate Wild and Scenic river areas	19% (12)	18% (12)	24% (10)	37% (9)	28.1 (9)
Set aside Research Natural Areas	17% (13)	18% (12)	23% (11)	31% (10)	25% (11)
Forest Health					
Plants and animals as a high priority	48% (3)	47% (3)	65% (1)	66% (1)	59% (1)
Consider forest appearance in making decisions	49% (2)	50% (2)	64% (2)	59% (2)	57% (2)
Allow lightning-caused fire to burn	20% (11)	21% (11)	25% (9)	26% (12)	24% (13)
Nonmotorized Recreation					
Open areas for recreation that are neither wilderness or roaded (motorized)	41% (6)	43% (5)	45% (4)	47% (5)	45% (4)
Created separate recreation areas for motorized and non-motorized use	43% (5)	34% (8)	41% (6)	47% (4)	43% (5)
Motorized Recreation					
Close some dispersed recreation sites	29% (10)	31.1 (9)	43% (5)	48% (3)	41% (6)
Create designated ATV trails	43% (4)	46% (4)	34% (8)	38% (8)	40% (7)
Limit camping to designated sites in heavily used areas	34% (8)	34% (7)	39% (7)	44% (7)	40% (7)
Provide more roads for access	35% (7)	36% (6)	22% (12)	22% (14)	27% (10)
Modern facilities for recreation	29% (9)	30% (10)	19% (14)	22% (13)	24% (12)
Commodity Flows					
Continuity commodity uses of forest	55% (1)	61% (1)	52% (3)	46% (6)	51% (3)

The previous table showed results when respondents were allowed as many preferences as they wished. The next table shows how respondents reacted when they faced trade-offs and had to rank benefits of forest management. Respondents were asked about nine public

benefits of Forest Service management in terms of their importance to them. Each public benefit was rated on a scale of 1 to 9, with 1 being most important and 9 being least important to the respondent. Benefits are listed in their overall rank order.

Table 3-214. Public benefits identified by SAFCA respondents in median rank (1 = highest priority, 9 = lowest priority) and rank order (in parentheses).

Public Benefit	Category	Big Horn	Washakie	Johnson	Sheridan	Total
Provide and protect sources of water for human use	Commodity Flows	1.77 (2)	1.91 (2)	1.31 (1)	1.12 (1)	1.40 (1)
Forest is available for future use	---	1.73 (1)	1.55 (1)	1.55 (2)	1.69 (2)	1.66 (2)
Provide healthy home for wildlife	Forest Health	2.51 (3)	2.58 (3)	2.13 (3)	1.88 (3)	2.13 (3)
Provide a place for people to relax	Recreation	3.62 (5)	3.68 (4)	3.73 (5)	3.33 (4)	3.46 (4)
Support Traditional ways of life for local communities and individuals	---	2.84 (4)	3.92 (5)	3.63 (4)	5.47 (6)	4.01 (5)
Provide recreational opportunities	Recreation	4.08 (6)	4.03 (6)	4.4 (6)	4.16 (5)	4.16 (6)
Provide timber	Commodity Flows	4.96 (7)	5.31 (7)	5.5 (7)	5.96 (7)	5.64 (7)
Provide grazing land for livestock	Commodity Flows	5.56 (8)	5.32 (8)	5.54 (8)	6.63 (8)	6.18 (8)
Provide minerals	Commodity Flows	6.99 (9)	6.57 (9)	7.31 (9)	7.55 (9)	7.35 (9)

There are two benefits that do not fit neatly into single categories: making the forest available for future use and supporting traditional ways of life for local communities. Both of these can be accomplished using passive or active management of the forest. Some individuals believe that setting aside more land for preservation is the way to make sure the forest is available for future use, while others believe logging and preventing catastrophic fire is the most reasonable insurance policy. Given that this table is the result of surveying local area residents, traditional uses in this context are likely to have a commodity orientation. Water has been categorized as a commodity given its long history of market transactions, portability, and vital input in agriculture. The commonality of ranking among respondents by county is remarkable. It must be noted, however, that clearly-stated preservation and designation management options were not among the benefits respondents were asked to rank.

Comparisons of national and local survey results are discussed in the following section.

Preservation/Designation

NSRE: Generally, the preservation of a “wilderness” experience and the designation of wilderness are seen by the public as at least somewhat important objectives to pursue. Metropolitan residents show the strongest support for this objective in both the East and West. Among non-metropolitan residents, those in the East show stronger support than those in the West for the designation of additional wilderness.

SAFCA: When asked about preservation-related issues, fewer local residents stated a preference for these kinds of forest management options. Across all four counties, “Set aside land for wilderness” was one of the least preferred management options (14th out of 14). Fewer than one in five residents from the west side counties (Big Horn and Washakie) cited “Designate Wild and Scenic River areas” or “Set aside Research Natural Areas” as a desired preference for Bighorn National Forest management. Strong support on the east side was also absent, as only 23 to 36% of residents identified these management options as desired.

The previous table does not provide additional information on the subject of preservation or designation. When asked to rank public benefits of forest management, respondents were not presented with a benefit which was uniquely associated with preservation and non-use of the Forest.

Forest Health

NSRE: The public sees the protection of watersheds and ecosystem health as an important objective for public land management. In the West, those in metropolitan areas see this as a more important objective than do their non-metropolitan counterparts. The public also agrees that this is an important role for the Forest Service, with metropolitan dwellers in the West viewing this as slightly more important role for the agency than those in the non-metropolitan West. The agency is also given a favorable evaluation for its performance in this area, with metropolitan westerners giving higher ratings than non-metropolitan westerners.

The protection of ecosystems and habitats and the restriction of natural resource extraction are seen as important objectives. The public also sees these activities as appropriate roles for the Forest Service. Again, where statistically significant differences between demographic groups occur, metropolitan dwellers are more in favor of such policies than are those living in non-metropolitan areas.

SAFCA: Giving plants and animals high priority in forest management was the highest overall preference of Bighorn area residents. At the same time, consideration for the scenic value of the Bighorn National Forest was the second most popular preference among residents on both sides of the mountain. On these specific topics, local residents were in agreement with national preferences for a healthy landscape. When it came to a particular management option for achieving healthy ecosystems—allowing lightning-cause fires to burn—the number of respondents citing this preference dropped in half from the more generally stated preferences given above. It is difficult to say how much of the national audience would agree with locals on this point.

When asked to rank public benefits, local respondents ranked “provide a healthy home for wildlife” very high. Only the production of water and assuring future use of the forest ranked higher.

Nonmotorized Recreation

NSRE: The agency is viewed as doing a somewhat favorable job providing nonmotorized access. Support for nonmotorized recreation opportunities is stronger in metropolitan areas than non-metropolitan areas. Separating these often conflicting types of pursuits by designating trails for specific uses is seen as a somewhat important objective, with higher support outside of metropolitan areas.

SAFCA: Residents on both sides of the Forest believe that providing for nonmotorized recreation is important. This use of the forest was identified by four in ten of the respondents as desirable.

Local residents ranked recreation opportunities and a setting for relaxation as mid-range benefits of the Forest. These benefits ranked lower than water, wildlife, and future use options, but higher than grazing, minerals and timber production. Residents were not offered a choice between different types of recreation, so the benefits of motorized and nonmotorized recreation cannot be compared here.

Motorized Recreation

NSRE: The provision of increased access for motorized recreation is seen as a slightly unimportant objective for public land management and is also viewed as a slightly unimportant role for the Forest Service. Non-metropolitan easterners and metropolitan westerners see motorized access as a more important objective than do non-metropolitan westerners and metropolitan easterners.

The American public is divided in its opinion about the provision of access. This is evidenced by the difference between support for motorized access and support for nonmotorized access. Motorized recreation is not a high priority objective, while preserving the ability to have a “wilderness experience” is important.

The expansion of off-highway motorized access and the development of new paved roads are somewhat unimportant objectives and the provisions of trails for motorized access are slightly unimportant to the public. Contrast this with the provision of nonmotorized access, which is viewed as a somewhat important objective to the public.

SAFCA: Motorized recreation poses some of the most contentious management preferences for the Bighorn NF. Across all counties, 40% of respondents prefer limiting camping to designed sites when the area was heavily used. The same can be said for designating ATV trails. Beyond these two, an east-west split was more apparent. Those citing the closure of some dispersed recreation sites, typically used by motorized recreationists, averaged 30% on the east side and over 40% on the west. Providing more roaded access and other modern facilities for recreation was preferred by only 20% of east side residents, but at least 30% of west side residents.

The amount of summer motorized use is an issue to the 4-county residents. More people indicated they would be either *positively or negatively* affected than *not* affected by decreasing the amount of summer motorized use. Of the other three management changes explored in that survey question (increased restrictions on grazing, decreased winter motorized use, decreased logging) more people were *not* affected by management changes than were *positively or negatively* affected.

Through the assessment and in written comments, many noted that "the mountain" was harder to access than 20 or even 10 years ago. Because access *to* the National Forest has not changed, this comment refers to motorized access *on* the National Forest. The perception is that there is less access because of road closures and restrictions on non-winter off-route travel. There have been travel management restrictions, usually for resource protection or because of user conflicts. As more people use the National Forest in the future, it is likely that additional travel restrictions will be necessary to maintain resources and quality recreation experiences. This is not expected to vary by alternative since it is more dependant upon future recreation use levels than alternative management strategies. See the nonmotorized discussion above regarding the ranking of recreation.

Commodity Flows

NSRE: These items address determination of the level of commodity uses of public lands. These objectives are supported at least moderately by the public. Members of the public more familiar with the multiple use objectives of the National Forest System lands are less likely to support policies that eliminate timber harvest and mining in order to preserve natural resources. These same respondents are also less likely to see the protection of ecosystems and watershed and the preservation of a wilderness experience as appropriate roles for the Forest Service.

SAFCA: Local residents on both sides of the mountain generally looked favorably upon commodity flows. It was the most common preference among west side residents. East side residents also preferred conditions with commodity flows but somewhat more moderately.

The benefits of timber harvest, livestock grazing, and mineral extraction were ranked last among those offered to survey respondents. Unfortunately, it is not possible to compare this ranking with management options that were not offered to respondents, e.g. the benefits of preservation and designation management.

Community Identity

Based on the comments on the questionnaire and in-depth interviews with 43 community leaders, there is no doubt that the majority of the residents of the 4 counties have not only economic and recreational attachments to the Bighorn National Forest but also psychological attraction to "the mountain." The mountain represents, to some extent, a western lifestyle suggesting both strength and ruggedness. Proximity to the national forest lands was ranked either 4th or 5th of nine factors by the respondents on why they chose to live in the four counties while proximity to recreation opportunities was ranked 6th by residents in each of the four counties. Reasons for living in the area "for the wide open spaces" and "to avoid big city lifestyles" were ranked either 1st or 2nd, followed closely by "appreciate the rural lifestyle."

From these data, it is obvious that physical location, size and nearness of the Bighorn National Forest are critical elements in the defining why people choose to live near the forest.

Community identities (based on county data) are inextricably bound by the physical location of communities abutting the mountain. Proximity to recreation and economic opportunities provide much of the basis for small town lifestyles. Underlying much of the data discussed above is an explicit and implicit concern for possible forest management shifts. Somehow the status quo is comforting. Locals made evident that they want the "federal government to include the needs and wants of local communities in making long-term management decisions." On a five-point scale, 62% checked strongly agree on this item (low of 55.2% for Sheridan County and high of 70.8% for Big Horn County residents). Likewise 2 of 3 respondents checked strongly agree on "how the USFS manages the national lands matters to me." Dependency on forest service management is reflected in the questionnaire responses to benefits provided by the USFS where "provide and protect sources of water for human use," and "make sure the forest is available for future use" were ranked 1st or 2nd of nine possible benefits provide by the forest followed closely by "provide a healthy home for wildlife" which was ranked 3rd by respondent in the four counties. Two-thirds of the interviewees felt that their communities were dependent on public land resources and nearly half identified themselves as taking an environmental stand. Two-thirds of the 43 interviewees spontaneously discussed the aesthetic importance of the Big Horns to their communities' identities.

Local populations have become more leisure oriented, and they look to the National Forests and Grasslands for their 'home away from home.' Some concerns over managing the Forest for recreation have to do with the influx of newcomers who crowd the local recreation areas. Local residents are most affected by visitors who have little regard for area standards, environmental ethics, and respect for the resource.

As communities around the Forest have seen a shift from commodity uses to amenity uses of public and private lands, there has been a domino effect on the composite values and lifestyles of local populations. For instance, it has become more difficult for young people to stay in the 4-county area after graduating from high school or college because of the lack of jobs with wages to support a family. More recreation and tourism jobs are in the service sector, where jobs are relatively lower paying than manufacturing jobs. This has accentuated the rise in local median age. New residents from outside Wyoming have brought with them a different set of values that emphasize amenities over commodities. As young locals move away, the influence of new residents is strengthened resulting in value and lifestyle shifts that happen more quickly.

Residents and county representatives expressed concern over recent changes in land uses on private lands inside and adjacent to the Forest. Nationally and locally, there is an increasing desire for people to live in open space 'ranchettes'. The American dream is no longer just to have a house, but it is to have a house on two- to five-acre lots. In Sheridan and Johnson counties, the conversion from a ranching way of life has been dramatic. This has been fueled by the attractive quality of life in the area, an aging national population with increasing numbers of retirees; and low taxes and relatively low property prices, especially when compared to states like Colorado and California. The 'no income tax benefit' has been used in advertising at least

one Sheridan County subdivision on Denver radio. In addition, with increasing land prices in Sheridan and Johnson counties, some ranchers simply choose to sell their land, especially when nearing retirement. As a result of these land use changes, locals have expressed concern over housing and the threat of wildfire, and maintaining watershed integrity. Land use is further discussed in the Local Governments subsection, along with land use planning.

The timber industry, in part because of its long history on the Forest, is viewed much like ranching, as part of the local way of life. Timber people see themselves as part of the solution in maintaining a healthy forest. Owners and representatives of small mills, a few of which remain in the area, have a strong affiliation with the forest resource base and a strong sense of community responsibility. Since at least the turn of the century, local timber operators have contributed to Wyoming's natural resource culture and economic development.

ENVIRONMENTAL CONSEQUENCES

Direct and Indirect Effects

Since the 1985 Forest Plan was approved, sentiment has shifted toward amenity values and away from a strong reliance on commodity values for public lands. As part of the National Forest System response to shifting public values, management of the Bighorn National Forest has gradually shifted as well. The alternatives considered respond primarily to this range of values.

Each alternative addresses the preferences of local and national stakeholders differently. Using some of the desired conditions expressed by the local public in Table 3-213, the following table shows how the alternatives compare in 'satisfying' the stated desired condition. These rankings compare alternatives with each other. The alternative rated best at satisfying a particular desired condition does not mean that it is the optimum possible for doing so – just that it is the best among the alternatives considered in detail. They also do not reflect whether 'satisfying' the desired condition statement is 'good' or 'bad'. The table below should not be confused with decision criteria used by the Regional Forester (see Record of Decision); however, it is a good indicator of the public values for which each alternative was designed.

Table 3-215. Alternatives compared to desired conditions.

Category/ Desired Condition	Alternative Rank					
	Best Satisfies the Desired Condition		←————→ Least Satisfies the Desired Condition			
Preservation/Designation						
Set aside land for wilderness	C	D-FEIS	A, B, D-DEIS, E are the same			
Designate Wild and Scenic river areas	B, C are the same		A	D-FEIS	D-DEIS, E are the same	
Set aside Research Natural Areas	B, C, D-DEIS are the same			D-FEIS	A	E
Forest Health						
Plants and animals as a high priority	B	A	D-FEIS	E	D-DEIS	C
Consider forest appearance in making decisions	C	B	D-FEIS	D-DEIS	A	E
Allow lightning-caused fire to burn	C	B	A	D-DEIS	D-FEIS	E
Nonmotorized Recreation						
Open areas for recreation that are neither wilderness or roaded (motorized)	B	C	A	D-FEIS	D-DEIS	E
Created separate recreation areas for motorized and non-motorized use	C	D-FEIS	B	D-DEIS	A	E
Motorized Recreation						
Close some dispersed recreation sites	Alternatives do not vary by this item					
Create designated ATV trails	Alternatives do not vary by this item					
Limit camping to designated sites in heavily used areas	Alternatives do not vary by this item					
Provide more roads for access	Alternatives do not vary by this item					
Modern facilities for recreation	Alternatives do not vary by this item					
Commodity Flows						
Continue commodity uses of forest	E	A	D-FEIS	D-DEIS	B	C

Alternatives C and E are most often identified with either best or least satisfying the stated desired conditions. Alternatives D-DEIS and D-FEIS are most often in the middle, rarely excelling in or poorly satisfying any desired condition. Alternatives A and B are somewhat between the extremes and middle ground of the others.

Preservation/Designation

Alternatives B and C do the best job of responding to these preferences, while Alternatives A and E satisfy them the least. National population preferences are often more aligned with these values, and therefore Alternatives B and C best respond to their desired condition sets. This was evident in the comments received by non-locals on the Draft EIS. Most non-locals cited a preference for wilderness in future Bighorn NF management. Local residents are not as strongly aligned with these values, yet some locals also listed these preferences. The social assessment indicated that there was mixed support for additional wilderness and protecting the biological diversity and integrity of the land: some strongly in favor, some strongly opposed. Among local commentors on the Draft EIS, multiple uses were most often cited as their preference for forest management, rather than wilderness designation.

Alternative C increases wilderness acreage by 17% (compared to existing). Research Natural Areas prohibit summer motorized recreation and would increase from two (1,449 acres) to six (21,190 acres) in Alternatives B, C, and D-DEIS and to four (6,406 acres) in Alternative D-FEIS. There would be no change in the number or acreage of RNAs in Alternatives A and E.

Forest Health

Alternative B most often satisfies these preferences, while Alternative E is the least effective. Alternatives D-FEIS is slightly better than D-DEIS in effectively satisfying forest health preferences. Management efforts to maintain a healthy forest for future generations also have the possibility of restricting some forms of recreation.

Both local and national interests believe forest health to be very important in forest management. However, it is important to note that the public's perception of a 'healthy forest' is very different depending on their preservation/utilitarian outlook for National Forest management. That is, many people believe that a healthy forest is best maintained by allowing natural processes (wildfires, insects and diseases, wind events) to be the primary influence upon the forest, while others believe that forest health is maintained by active silvicultural management.

Nonmotorized Recreation

Alternatives C, B, and D-FEIS satisfy these preferences the best; Alternatives A and E satisfy them the least. National populations have cited this as very important for forest management generally, with agreement by 4 in 10 local residents.

Over the long-term, management actions that impact various types recreation will have the greatest direct effects on the residents of the four counties. Also, the fact that different types of recreation users compete for the same resource poses the possibility of conflict (i.e., motorized and nonmotorized). The restrictions on non-winter off-road/off-trail

motorized travel will most likely be viewed favorably by those who go to the forest for spiritual and mental renewal and for those who use the forest for horseback riding.

Alternative D-FEIS places more emphasis on providing areas for easily accessible winter nonmotorized recreation. Turkey Creek, Salt Creek, and an area near Powder River Pass provide highway access to areas that will be closed to snowmobiles to provide for ‘untracked’ backcountry ski opportunities. Alternative C includes only the Salt Creek drainage for backcountry skiers. Overall, Alternative C provides the greatest amount of quiet (i.e., nonmotorized) winter areas.

Motorized Recreation

Preferences for both national and local populations were the most polarized regarding motorized recreation. All alternatives treat these preferences equally. Those who engage in four-wheeling will be most affected by the conversion of the remaining “C areas” (where wheeled motorized travel off system roads and trails is still allowed) to “A areas” which will prohibit non-winter motorized travel off system roads and trails. The conversion from “C” to “A” areas will occur under all alternative and will affect 11% of the Bighorn National Forest.

The Forest’s goal of decommissioning four miles of road per year will not vary by alternative. Alternatives A and E could potentially result in road construction into the Piney/Rock area. Given the length needed, these roads could remain open for public use, unlike most timber roads. This would result in additional access within the Forest.

The alternatives vary from a low of 61% of the forest being open to snowmobiles in Alternative C to a high of 72% of the forest being open to snowmobiles in Alternatives A and E. Alternatives D-FEIS and D-DEIS both have 69% of the forest open to snowmobiles. The designated snowmobile trail system does not vary by alternative. Alternative C, with the least acreage available to snowmachine travel, could concentrate snowmobile use, potentially resulting in a greater perception of crowding.

Across all alternatives, forestwide direction would prohibit, or mitigate through other management practices, dispersed camping near lakes and streams. This reflects a targeted effort to address resource impact and water quality concerns in high use areas and does not vary by alternative.

Commodity Flows

Livestock grazing and timber harvest have been among the most discussed aspects of the plan revision process. Because the Revised Plan decision does not directly affect permitted grazing levels, future permitted AUM (animal unit months) projections do not vary by alternative. Actual grazing levels are set during the allotment management planning process and in annual operating plans. More than one ranching stakeholder argued powerfully that forest grazing enabled ranchers to keep from subdividing private land, thus protecting open space. Likewise, Johnson County residents viewed grazing second only to tourism in forest-related economic benefits. Only in Sheridan County did residents identify grazing as the least significant economic sector.

Unlike grazing, timber varies greatly by alternative. Thus the degree of satisfaction by alternative in the above table is directly correlated with projected timber harvest. Alternatives A and E best satisfy these preferences, while Alternatives B and C satisfy them the least. Alternatives D-FEIS and D-DEIS range in the middle ground. Satisfaction of this preference aligns most with local populations.

Perceived Effects of Management Decisions

Local residents were asked how various management decisions might affect them. The following table summarizes their responses. For example, people were asked if increased restrictions on grazing would negatively, positively, or not affect them personally. Decreased summer motorized use is the most “polarized” issue, as the number of respondents positively and negatively affected both exceed the number of people not effected.

Table 3-216. SAFCA respondents negatively, positively, or not effected by selected potential management strategies.

Type of Management Decision	Negative Effect	No Effect	Positive Effect
Increased Restrictions on Grazing	21.8%	52.7%	25.5%
Decreased Winter Motorized Use	29.6%	46.5%	23.9%
Decreased Summer Motorized Use	42.0%	26.6%	31.4%
Decreased Logging	29.0%	50.1%	20.9%

Community Identity

Important identity attributes and lifestyle trends in Bighorn communities are not expected to be accentuated or diminished because of forest plan decisions. Many lifestyle changes discussed above are the result of large-scale demographic and market forces. Small communities seek the latest technologies in communications to enhance their economic development potential, but it is often these very technologies that remove local insulation from national and international forces. Trends in migration, economic growth, private land use, tourism, and ranching in the Bighorn area will not be significantly affected by the Revised Plan. The lifestyle changes felt in Bighorn communities resulting from these trends are likely to continue

Cumulative Effects

There are no cumulative impacts to the preference sets of local or national populations about Bighorn National Forest management for any alternative. Some may argue that actions on neighboring lands, either public or private, could potentially affect some preference sets. However, there are no data available to confirm this supposition or to measure the potential. Because no direct and indirect effects to community identity are anticipated, there are no cumulative effects.

Economics

AFFECTED ENVIRONMENT

The economic consequences of the Bighorn National Forest stretch across much of Wyoming and into southern Montana, but the 4-county area of Big Horn, Johnson, Sheridan, and Washakie counties was recognized as most affected by the Forest. There are substantial differences in the economic structure of counties on the west and east side of the Big Horn Mountains. In addition, there are significant economic linkages between counties on either side of the mountain, particularly between Sheridan and Johnson. Because of these differences, economic modeling and the data presentations are displayed for the west side of the mountain (Big Horn and Washakie Counties) and the east side of the mountain (Johnson and Sheridan Counties).

Comprehensive economic data are generally unavailable at the community-level. However, interpretations of larger-scale analyses can sometimes be made and offer insights into particular communities. These are presented where possible.

Employment and Income

The current distribution of employment, the trends in employment, and average earnings per job are important measures of a county's economic health. Employment is reported by the U.S. Bureau of Economic Analysis and in this FEIS on an "annual monthly average" basis. This means that twelve monthly employment estimates are averaged for the given year – in this case 2002. For those sectors that are highly seasonal, with high employment during several months and low employment during the remainder of the year, the estimates may seem low but are correct.

The following table shows that government is the leading employer on both sides of the mountain. Local governments, including school districts, dominate this sector. Agriculture, mining, and manufacturing are far more prominent in on the west side, reflecting the natural resource base of the economy. Worland is unique among Wyoming communities as a center of manufacturing, lead by bottling of soft drinks and water and by sugar beet processing. The east side is a small-region service center and therefore dominated by the trade and service sectors. The importance of tourism is also evident in these sectors. Sheridan and Buffalo are common stops for tourists en route to Yellowstone, recreating in the Bighorn area, or just passing through via Interstates 25 and 90. Commercial travelers and recent coalbed methane activity have also made these communities popular stops.

CHAPTER 3
AFFECTED ENVIRONMENT & ENVIRONMENTAL CONSEQUENCES

Table 3-217. Employment by major industry, 2002 (jobs).

Industry	West Side	East Side	Area Total
Government	2,375	3,814	6,189
Other Services	1,307	3,583	4,890
Wholesale & Retail Trade	1,251	2,786	4,037
Accommodations & Food Service	800	2,073	2,873
Agriculture & Natural Resources	1,362	1,475	2,837
Construction	856	1,786	2,642
Transportation, Information, Utilities	648	1,510	2,158
Finance, Insurance, & Real Estate	529	1,496	2,025
Professional & Admin Services	457	1,334	1,791
Mining	1,117	435	1,552
Manufacturing	868	575	1,443
Arts, Entertainment, & Recreation	183	351	534
Total	11,754	21,218	32,972

Source: IMPLAN and the University of Wyoming

The following table shows labor income for the area. Labor income includes all wages and salaries plus benefits for employees and self-employed. This table follows the same pattern shown above for employment, with some notable exceptions. Mining and manufacturing, especially on the west side, provide substantially more income to workers than the area average. Finance, insurance, and real estate offer more income to workers on the east side. Earnings in the arts, entertainment, and recreation sector are nearly ten times higher on the east side, as compared with the west – yet employment is only 5 times higher. This is likely a reflection of a strong tourist economy in Sheridan and Johnson Counties. It may also reflect the numerous retirees that have been attracted to the east side in recent years.

Table 3-218. Labor earnings by major industry, 2002 (\$ thousand).

Industry	West Side	East Side	Area Total
Government	\$83,609	\$156,813	\$240,422
Other Services	\$30,033	\$83,470	\$113,503
Wholesale & Retail Trade	\$26,447	\$64,729	\$91,176
Transportation, Information, Utilities	\$30,891	\$59,683	\$90,574
Construction	\$29,602	\$58,650	\$88,252
Mining	\$51,961	\$22,736	\$74,697
Finance, Insurance, & Real Estate	\$12,104	\$45,324	\$57,428
Professional & Admin Services	\$13,144	\$43,231	\$56,375
Manufacturing	\$39,121	\$16,430	\$55,551
Accommodations & Food Service	\$7,168	\$25,783	\$32,951

Industry	West Side	East Side	Area Total
Agriculture & Natural Resources	\$12,417	\$12,106	\$24,523
Arts, Entertainment, & Recreation	\$1,939	\$8,514	\$10,453
Total	\$338,436	\$597,469	\$935,905

Source: IMPLAN and the University of Wyoming

Another important aspect of a county's economy is the sources of personal income for workers and residents. Personal income, as shown in the following table, is composed of three parts: 1) labor earnings that represent wages, salaries, and proprietor (i.e., self-employed) income, 2) investment income which represents property income from dividends, interest, and rent, and 3) transfer payments which are primarily government payments to individuals such as Social Security, Medicare, and Medicaid.

Table 3-219. Personal income by source, 2003.

Income Source	West Side	East Side	Wyoming	United States
Transfer Payments	17.4%	13.9%	13.0%	14.6%
Investment Income	22.4%	30.6%	22.9%	16.1%
Labor Earnings	60.2%	55.5%	64.1%	69.3%

Source: US Department of Commerce, Bureau of Economic Analysis, Regional Economic Information System, 2003.

Labor earnings are considered to be "earned income," while transfer payments and investment income are considered to be "non-earned income." According to the Economic Analysis Division of the state of Wyoming, non-earned income is becoming increasingly important in Wyoming (State of Wyoming 2001). Both west and east sides of the Bighorn area exceed the state and national share of non-earned income, with Sheridan and Johnson Counties having a substantial portion of non-earned personal income. Counties with a high percentage of non-earned sources of income will be less vulnerable to local economic shocks, but may be more vulnerable to national economic shocks. Those counties with a higher percentage of dividends, interest, and rental income will have more exposure to fluctuations in the national economy. Conversely, because transfer payments largely consist of social security payments, counties with a high proportion of transfer payments will experience less variation since transfer payments are more stable (ibid).

As a population ages, dividends, interest, and rent and transfer payments can be expected to increase as a percentage of total personal income. Age information presented earlier shows that residents of Bighorn National Forest counties are old, and getting older, relative to the rest of the U.S. and Wyoming. The relatively high level of investment income in this part of Wyoming is another indicator of an aging population. It also indicates a substantial retirement component in the economy. The indicators of an aging population, whether home-grown or caused by in-migration, have a bearing on recreation management of public lands. Motorized recreation is typically preferred by and sometimes the only option for an aging population.

Major Communities near the Bighorn NF

Big Horn County

- ◆ Lovell is the largest town in the northern half of Big Horn County, and provides a service center for the smaller communities of Frannie, Deaver, and Cowley. The largest employers include BPM Minerals LLC and American Colloid, both of whom mine bentonite. A Georgia Pacific plant that produces gypsum and wallboard, and GK Construction, which deals in mining and hauling, are also major private sector employees. Adding value to local agriculture production, Western Sugar has a facility in Lovell that refines sugar beets. Lovell also serves as a base for outdoor recreation pursuits in the Bighorn Canyon National Recreation Area and other public lands nearby.
- ◆ Greybull and Basin are the largest towns in the southern half of Big Horn County. Basin is the county seat. The largest employers include M-I Drilling and Wyo-Ben, both bentonite mines north of Greybull. The Burlington Northern/Sante Fe Railroad is another major employer in the area. Highline Enterprises, known previously as Cowboy Timber, is the second largest sawmill in the four-county area. The mill is located in Manderson, about half way between Basin and Worland.

Washakie County

- ◆ Worland is the demographic, economic, and governmental center of Washakie County. Worland is the largest town on the west side of the Big Horn Mountains and has become a small regional service center. Worland's economy was founded on agriculture, and then diversified into related industries. As a result, the strong manufacturing sector of the west side is centered in Worland. The largest employers today are Wyoming Gas, Wyoming Sugar Corporation, RT Communications, Admiral Beverage/Pepsi-Cola, and Crown Cork and Seal. Worland is also known for its artesian wells and the high quality water that flows from them. Worland is home to the largest medical center and only commercial airport on the west side.

Johnson County

- ◆ Buffalo, located at the junction of I-90 and I-25, is the seat and largest community in Johnson County. Buffalo is the major government and service center for Johnson County. 3-Way Construction and Ouray Sporting Goods are the leading private sector employers in the community. Because Buffalo is only 20 minutes from Sheridan, much of the work force commutes on I-90 between the cities.

Sheridan County

- ◆ Sheridan is the largest community in the Bighorn area, having a population that nearly equals all other communities combined. Sheridan is the regional service and tourist center of the Bighorn area, and consequently dominates the economy of the east side. The largest private employers are Wal-Mart and Sugarland Enterprises (dba Holiday Inn). There are several large public sector employers including the Veterans Administration Medical Center, Memorial Hospital, and Sheridan College. Sheridan is home to Wyoming Sawmills, Inc., the largest sawmill in the area. Air service to Sheridan is provided by daily flights from Denver and Billings. With a wide array of

service, trade, health, communication, and transportation businesses, retirees have become an increasingly important part of the Sheridan economy.

Cost of Living

Although the cost of living in the Rocky Mountain West is somewhat higher than many parts of the country, Wyoming is close to the national average. The cost of living in Wyoming, however, varies greatly depending upon the community. This is true for the Bighorn area as well. As part of the Wyoming Cost of Living Index, prepared by the Wyoming Department of Administration and Information, Sheridan, Buffalo, Worland, Greybull, and Lovell are surveyed quarterly. As a result of surveys conducted during January 2005, Worland, Greybull, and Lovell showed a very low cost of living. Housing in these communities was among the most affordable in the state. In contrast, Sheridan and Buffalo were in the highest third of living costs in Wyoming. While housing was near the state average, food and apparel were among the highest in the state. High prices for food and apparel are consistent with other tourist-based economies in the state.

Economic Dependency

Every economy has one or more ‘engines’ that ultimately provide residents with jobs and income. In a real sense, area jobs and income depend on the size and vitality of these engines.

The economic dependency of the planning area can be discerned by breaking down employment into three components: basic industries, indirect basic industries, and local resident service (sometimes called induced) industries. *Basic industries* are those that bring money in from outside the area. This is done by exporting goods and services or selling them to non-residents. Tourism is an example of an export industry in the planning area. Other export industries are livestock and manufacturing. *Indirect basic industries* are those that support the basic industries. These commonly include local suppliers of goods and services to basic industries. Wholesale trade and trucking would be examples of indirect basic industries. The third component is *local resident services*. These industries provide local residents such services as grocery stores and medical care.

By incorporating the concept of economic multipliers to basic industries, the total effect that these industries have on the economy can be determined. The following two tables show the share of **all** jobs throughout the economies of the west and east sides that are generated by sales in the listed industry. For instance, sawmills generate jobs in the utilities industry by purchasing electricity and in the trade industry by purchasing supplies. In a dependency analysis, all of these jobs are shown under the basic industry that ultimately generated the employment, e.g., sawmills (manufacturing).

The following table shows the commonalities and differences between the economies of the west and east sides of the Bighorn National Forest. There are two basic sectors that contribute similarly to the local economy on each side of the mountain: government and agriculture. Government (federal, state, and local) is the largest basic source of employment in the planning area, accounting for about a fifth of all jobs in a variety of sectors. Agriculture, an historically

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important and culturally significant sector in the entire planning area, accounts for 7-8 percent of all jobs on each side. The balance of the economy on each side is strikingly different. On the west side, manufacturing and mining combined support a quarter of all jobs in Washakie and Big Horn Counties. The combined importance of agriculture, mining, and manufacturing on the west side indicates that this economy continues to be driven by traditional engines. Many economies in the rural West no longer exhibit this composition, having shifted to a service base. The east side is a good example of this trend. Half of all jobs in Sheridan and Johnson Counties are provided through the trade and service sectors. The prominence of these sectors indicates that Sheridan is both an important regional service center and an important tourist center. Retirees have always had a larger presence in Sheridan, but the growth of this age group through in-migration contributes to the tourism and service center foundations of this economy.

Table 3-220. Economic dependency by employment, 2002.

Economic Sector	West Side	East Side
Government	22%	18%
Other Service	11%	16%
Agriculture and Natural Resources	8%	7%
Mining	10%	2%
Construction	8%	11%
Manufacturing	15%	4%
Transportation, Information, Utilities	4%	7%
Wholesale and Retail Trade	9%	12%
Finance, Insurance and Real Estate	4%	7%
Professional and Admin. Services	2%	4%
Arts, Entertainment, Recreation	1%	1%
Accommodations and Food Services	6%	10%

By considering the dependency analysis above with the personal income data discussed earlier, the vulnerability of these economies can be seen. Dave Spencer, Wyoming Business Council Regional Director for Northeast Wyoming, points out the following concerning the economic vulnerability of Sheridan and Johnson Counties:

“Both counties have experienced a healthy population growth in the past decade with Sheridan County growing about 12% in the last census period and Johnson County about 15%. This growth has however masked the real underlying structural economic problems of both counties and given a false sense of prosperity to local residents. Increased construction activity and new transfer payments circulating in the economy have given each county a bustling feeling which camouflages the real problems in employment and income. Neither county is very well diversified with Sheridan County particularly dependent on services, retail, and government with a strong construction component as the main sources of the earned income portion of the economy. Johnson County is the same with an added dependence on agriculture that is much stronger than the average in the State. Diversification has eluded both areas although Sheridan is making some good efforts now in that direction. In both

counties the overwhelming drivers of the economy are interest, rents and transfer payments, not earned income. The upshot is that both counties are lagging in income growth and very vulnerable to external shock.”

Because the economy of the west side is more dependent upon traditional economic engines and comes closer to reflecting the personal income shares of the U.S. as a whole, it does not share the vulnerability of the Sheridan and Johnson Counties. Economic growth, however, has not been as strong on the west side.

The following tables illustrate the employment and labor income contributed to area economies by use and management of the Bighorn National Forest. As shown in the following table, employment associated with the Bighorn NF accounts for about five to seven percent of the total employment in the area, with the major contributions made to the service and trade sectors. The small contribution to manufacturing has resulted from very low timber harvest levels on the forest in recent years. About one in fourteen agriculture jobs are attributable to grazing on the Bighorn National Forest.

Table 3-221. Bighorn National Forest contribution to the planning area employment by major industry, 2002 (jobs).

Industry	West Side Big Horn, Washakie			East Side Johnson, Sheridan		
	Forest-related	Total Area	Percent of Total Area	Forest-related	Total Area	Percent of Total Area
Agriculture & Natural Resources	87	1,362	6.4%	105	1,475	7.1%
Mining	0	1,117	0.0%	1	435	0.2%
Construction	5	856	0.6%	10	1,786	0.5%
Manufacturing	3	868	0.3%	9	575	1.6%
Transportation, Information, Utilities	9	648	1.4%	22	1,510	1.5%
Wholesale & Retail Trade	131	1,251	10.5%	236	2,786	8.5%
Finance, Insurance, & Real Estate	24	529	4.5%	33	1,496	2.2%
Professional & Admin Services	15	457	3.3%	28	1,334	2.1%
Arts, Entertainment, & Recreation	140	183	76.7%	118	351	33.6%
Accommodations & Food Service	262	800	32.8%	418	2,073	20.1%
Other Services	26	1,307	2.0%	48	3,583	1.3%
Government	61	2,375	2.6%	124	3,814	3.3%
Total	764	11,754	6.5%	1,152	21,218	5.4%

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The table below shows the source of the Forest Service contribution to employment in terms of its natural resource programs. Recreation is by far the most important contributor to local employment, accounting for about three-fourths of all Bighorn-based employment. The recreation contribution is best understood as that portion of tourism attributable to the Bighorn National Forest in each area. Forest Service expenditures account for the next largest contribution to local economies. Local expenditures by the Forest Service can impact the local economy in two ways: 1) Forest Service employees receive paychecks and spend a portion of their wages locally and 2) the Forest Service purchases goods and services from local suppliers and contractors. Employment stemming from grazing on the Bighorn National Forest provides about 110 jobs on each side of the mountain. Because of the differing sizes of each economy, this is relatively more important to the west side. As noted above, low timber harvest levels in recent years have reduced the importance of timber-based jobs compared to other forest programs. Timber harvest and processing jobs are heavily weighted to the east side, primarily because of Wyoming Sawmills, Inc located in Sheridan.

Table 3-222. Bighorn National Forest contributions to the planning area employment by program, 2002

Resource Program	West Side BNF		East Side BNF	
	Jobs	Percent	Jobs	Percent
Recreation, except hunting & fishing	440	58%	689	60%
Hunting & fishing	143	19%	142	12%
Grazing	113	15%	115	10%
Timber harvest	1	0%	23	2%
Forest expenditures	68	9%	184	16%
Total forest management	764	100%	1,152	100.0%

The above tables provided a look at Bighorn National Forest contributions in terms of jobs. The picture changes somewhat when it is looked at in terms of labor income, as shown in the next two tables. The Bighorn National Forest contribution to area labor income is about half of the contribution by employment (2.9% vs. 6.6% for the west side; 3.5% vs. 5.4% for the east side). In general, service and trade related jobs are lower paying than most of the other economic sectors, and service and trade are currently the sectors of greatest relative contribution from the Bighorn NF. Because most of the employment generated by the Bighorn National Forest is tourism related, the share of total labor income from the Forest is reduced.

Table 3-223. Bighorn National Forest contribution to the planning area labor income by major industry, 2002 (\$ thousand).

Industry	West Side Big Horn, Washakie			East Side Johnson, Sheridan		
	Forest-related	Total Area	Percent of Total Area	Forest-related	Total Area	Percent of Total Area
Agriculture & Natural Resources	1,825	12,417	14.7%	2,162	12,106	17.9%
Mining	19	51,961	0.0%	46	22,736	0.2%
Construction	146	29,602	0.5%	276	58,650	0.5%
Manufacturing	63	39,121	0.2%	242	16,430	1.5%
Transportation, Information, Utilities	326	30,891	1.1%	606	59,683	1.0%
Wholesale & Retail Trade	1,912	26,447	7.2%	3,613	64,729	5.6%
Finance, Insurance, & Real Estate	330	12,104	2.7%	807	45,324	1.8%
Professional & Admin Services	346	13,144	2.6%	771	43,231	1.8%
Arts, Entertainment, & Recreation	1,070	1,939	55.2%	2,321	8,514	27.3%
Accommodations & Food Service	2,205	7,168	30.8%	4,151	25,783	16.1%
Other Services	502	30,033	1.7%	1,094	83,470	1.3%
Government	1,142	83,609	1.4%	4,532	156,813	2.9%
Total	9,887	338,436	2.9%	20,622	597,469	3.5%

The following table shows that contributions to the labor income of the respective economies are much more balanced among forest programs as compared with employment. On the west side, grazing, timber, and the forest administrative expenses account for 38% of all generated income compared with only 24% of employment. On the east side, these same programs account for 44% of all generated income compared with only 28% for employment. These differences reflect the lower relative wage levels found in tourism-based sectors.

Table 3-224. Bighorn National Forest contributions to the planning area labor income by program, 2002.

Resource Program	West Side		East Side	
	\$ Thousand	Percent	\$ Thousand	Percent
Recreation, except hunting & fishing	\$4,560	46%	\$9,333	45%
Hunting & fishing	\$2,461	25%	\$2,543	12%
Grazing	\$1,571	16%	\$2,042	10%
Timber harvest	\$23	0%	\$692	3%
Forest expenditures	\$1,272	13%	\$6,012	29%
Total forest management	\$9,887	100%	\$20,622	100%

Bighorn National Forest-related Industries

Agriculture – Livestock

Data indicate that west side ranchers (permittees with base properties in Big Horn or Washakie Counties) are permitted to graze about the same number of animal-unit months (AUMs) as ranchers on the east side. Most livestock grazing on the forest involves fairly large commercial livestock operations. Ninety-two percent of all Bighorn grazing is by permittees with permits for 500 or more AUMs of livestock grazing on the forest. The average for these 500+ operations is over 1,200 AUMs. These 500+ AUM operations represent about three-fourths of the permittees on the Bighorn. This is in contrast to the agriculture industry as a whole that includes many who have small operations that might be considered second incomes or “hobby” ranches. This phenomenon may account for a much larger share of forest-based income in the agriculture industry as compared with forest-based employment. A “job” can be one person working either part-time or full-time, while labor income fully reflects hours of labor.

Livestock prices have been quite volatile over the years. For this reason, a single year price is not useful in long-range planning, and therefore a 10-year average (1994-2003) was used to value Bighorn National Forest livestock production. The 10-year average for cattle value of production, adjusted for inflation, was \$35.76 per animal unit month (AUM). For sheep, the inflation-adjusted average value of production was \$31.58 per AUM.

The following table summarizes the total economic impact of livestock grazing to the local four-county area in terms of employment and earnings. Firm-level research suggests that there are at least three possible perspectives to consider in evaluating the economic importance of Forest Service grazing: 1) considering the Forest Service AUMs only, 2) considering Forest Service AUMs and their effects on use of other forage sources in the grazing system, and 3) considering Forest Service AUMs and their effect on the economic viability of the ranching operation. Which of these perspectives is the most relevant depends on the ranch’s level of dependency on the Forest Service grazing, the magnitude of the proposed change, the financial solvency of the operation, the availability of alternative sources of forage, and the desire of the producer to remain in ranching. Due to the variability in these factors between ranches, it is difficult to generalize as to which

perspective is most appropriate. The grazing system perspective is used throughout the economic portion of this chapter.

Table 3-225. Total economic impact of Bighorn National Forest grazing program upon the local economies.

Bighorn NF Grazing Program (108,835 animal-unit months)	West Side		East Side	
	Jobs	Labor Earnings	Jobs	Labor Earnings
USFS permit only	49	\$1.1 million	50	\$1.1 million
Grazing System	113	\$2.5 million	115	\$2.5 million
Ranch viability perspective	250	\$5.5 million	255	\$5.6 million

Forest Products

Estimates of base year timber production from the Bighorn National Forest, in terms of total amount harvested and economic impacts, are based on the harvest history from 1994 to 2004. During that period, timber was harvested and processed in sawmills located in Buffalo, Cody, Manderson, and Sheridan, WY and in Livingston, MT. The percentage of timber volume going to those mills was used as a basis for estimating the timber economic impact upon the west side and east side economies. A detailed discussion of the timber industry and anticipated harvests can be found in the Timber Resources section of this chapter. The assumptions used in the analysis found in the Timber Resources section are the same as those used here to estimate economic impacts. See FEIS Appendix B for more details on economic impact methodologies.

Tourism

Recreation use on the Bighorn National Forest has been obtained from the National Visitor Use Monitoring (NVUM) system. Use data were aggregated into twelve major categories defined by the primary recreation activity. As discussed in the Recreation section of this chapter, nearly all recreation use is expected to increase in the near future. Snowmobiling and viewing wildlife/scenery are expected to grow the fastest. Only when the supply of Bighorn National Forest picnic grounds is reduced under Alternatives A and E does “other” recreation drop by 2010. Even with a very modest reduction in this catch-all category, total recreation use, including developed camping, increases.

To estimate the economic impact of recreation, local resident use was separated from use by other Wyoming residents and non-residents. This estimation is necessary since economic impacts are based on new dollars flowing into the regional economy. Spending profiles of non-locals were obtained from a variety of sources, as summarized in FEIS Appendix B.

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Direct and Indirect Effects

Direct and indirect effects on planning area jobs and income are generated by changes in recreational uses of the national forest; agency expenditures (salaries, equipment, contracts); and the use of timber and forage resources. A change in recreation or timber production may mean an increase in jobs and income to local communities. In addition, if production is decreased in one resource and increased in another, there is a shifting of jobs from one industry to another. To estimate changes in income and employment for each alternative, the forest used two computer models: one for the west side of the planning area (Big Horn and Washakie Counties) and another for the east side (Johnson and Sheridan Counties). See FEIS Appendix B for a more detailed discussion of the models and analysis methodology.

Employment and labor income attributable to the Bighorn National Forest are estimated for the year 2010 throughout the planning area. 2010 was selected because it is the mid-point of the next decade, and there could be some lag time for changes in program levels to materialize. The reference point for the west and east side economies is 2002 – the latest year for which complete economic data is available. Jobs are defined as annual average jobs – thus some may be part-time. Labor income includes all wages and salaries plus benefits paid by business proprietors to employees and themselves.

Outputs that represent recent forest activity and the local 2002 economy were used as a starting point. Impacts represent changes from this starting point to output levels that have been projected for 2010.

As shown above, there are five forest programs that can affect local economies: recreation, hunting and fishing (wildlife-based recreation), grazing, timber, and administrative expenses. Changes by alternative for each of these programs are as follows:

- ◆ **Recreation:** As discussed in the Recreation section, the total number of visitors to the Bighorn National Forest is projected to increase across all alternatives, with only a slight variation among alternatives based on program funding levels. Developed camping and picnicking at non-concessionnaire-operated sites would slightly decrease in Alternatives A and E. This corresponds with a slight variation in recreation-related jobs among the alternatives. National economic and demographic conditions (across all alternatives) have a greater influence on the overall number of non-local tourists coming to the Bighorn National Forest than potential visitor displacement anticipated under any of the alternatives. As an example, a change in travel management designation might shift motorized and nonmotorized users to different spots on the Forest, while dramatically higher national fuel prices might discourage visitors from driving to Wyoming to recreate on the Forest.

The visitor expenditure profiles used in the analysis were obtained from three sources, all of which were specific to Wyoming. Resident and nonresident fishing and hunting expenditures were based on Wyoming data from the U.S. Fish and Wildlife Service's

2001 National Survey of Fishing and Hunting, and Wildlife-Associated Recreation. Resident and nonresident snowmobiling expenditures were based on the *2000-2001 Wyoming Snowmobile Survey* conducted for the Wyoming State Trails Program by the University of Wyoming. Expenditure profiles for lodging based recreation activities including non-local overnight on the forest, non-local overnight off the forest, and non-local day use were based on Morey & Associates' *Report on the Economic Impact of the Travel Industry in Wyoming*, 1998 which was prepared for the Wyoming Business Council, Division of Tourism. All expenditures were adjusted to 2002 dollars to be compatible with the economic models.

- ◆ **Hunting and fishing:** As discussed in the Recreation chapter, hunting and fishing use is expected to increase from 4% to 7% by 2010. This increase is anticipated under all alternatives.
- ◆ **Grazing:** As noted above and discussed in the Livestock Grazing section, grazing production does not change by alternative.²⁷ Revised Plan direction for grazing is the same as that currently being implemented. Some permittees may maintain, or potentially even increase, the number of AUMs with more intensive management. Some permittees may choose to reduce AUMs because of market and personal factors that are outside the scope of this analysis. With regard to this Forest Service decision, there are no economic impacts attributable to grazing in the alternatives.
- ◆ **Timber:** As discussed in the Timber section, the timber industry associated with the Bighorn National Forest area has been undergoing major changes. Because of volatility in lumber markets and a recent history of reduced supplies from National Forests, firms have 1) adjusted their source of timber supplies, 2) updated their mill to improve efficiency, 3) changed their product mix, or 4) closed. This analysis assumes that remaining mills have successfully made adjustments and will continue to operate. The analysis also assumes that timber supplies from private, state, and tribal sources combined will decrease by about 10% in the near future. This assumption is based on expectations of industry observers that current timber supplies from these lands cannot be sustained over the long run. Two production scenarios were examined: Wyoming mills operating one-shift, as they have in recent years, and the same mills operating two-shifts. The range of timber offered by the Bighorn National Forest for each of the plan revision alternatives generally would continue support of Wyoming mills operating one-shift. Bighorn timber supplies, even at the highest alternatives, generally would not warrant two-shift operations in northern Wyoming mills.

²⁷ Forty AUMs would be lost if the proposed Lake McClain RNA is designated, a 0.03% reduction. This was considered to be too small of a change to actually detect; that is, it is within the margin of error of our projected AUMs and economic analysis. Therefore, the AUMs for the alternatives that include Lake McClain RNA were not changed. Lake McClain is a proposed RNA in Alternatives B, C, and D-DEIS.

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- ♦ **Administrative expenditures:** The Bighorn National Forest total operating budget does not vary by alternative. The forest budget is expected to be relatively stable after adjustments for inflation. How the budget is spent could vary by alternative, but the differences were not considered large enough to be meaningful in this analysis. Consequently, there are no economic impacts attributable to administrative expenditures in the alternatives.

The employment and income effects of the alternatives are illustrated in the following eight tables. The next two tables provide a look at employment effects by Forest Service resource program for the west and east sides of the forest. Notice that changes are estimated for 2010 but the base year is 2001-2002.

Table 3-226. Projected changes in west side employment by program by alternative in 2010 (jobs).

	Base Year (2001-2002)	Alternatives					
		D-FEIS	D-DEIS	A	E	B	C
Recreation	440	30	30	26	26	30	30
Hunt & Fish	143	4	4	4	4	4	4
Grazing	113	0	0	0	0	0	0
Timber	1	11	10	12	12	7	7
Expenditures	68	0	0	0	0	0	0
Total	764	45	43	42	42	40	40
% change	---	6%	6%	5%	6%	5%	5%

Table 3-227. Projected changes in east side employment by program by alternative in 2010 (jobs).

	Base Year (2001-2002)	Alternatives					
		E	D-DEIS	D-FEIS	A	B	C
Recreation	689	37	42	42	37	42	42
Hunt & Fish	142	4	4	4	4	4	4
Grazing	115	0	0	0	0	0	0
Timber	184	77	55	51	49	32	16
Expenditures	23	0	0	0	0	0	0
Total	1,152	118	101	97	90	78	62
% change	---	10%	9%	8%	8%	7%	5%

On the west side of the forest, changes are estimated to increase employment between 40 and 45 jobs. Most of the increase is attributable to forest-based tourism, but most of the variation is attributable to timber. While the effects from timber are likely to be experienced primarily in Manderson, some of the secondary and all of the tourism-based effects are likely to be felt in all communities. On the east side, increased employment ranges from 62 jobs to a high of 118. Because of a much large timber industry located primarily in Sheridan, timber is much more influential on the east side. Timber-based

employment accounts for only 25% of the change for Alternative C, but ranges up to 50% of the change for Alternative D-FEIS, and tops out at 65% of the employment for Alternative E. As explained in the Timber Resources section of this chapter, these jobs are not likely to be new, but may be supported with Bighorn NF timber rather than private sources. The tourism effect from out-of-area recreationists may also be centered in Sheridan. Buffalo and other towns may experience a small share of the estimated increases.

The previous tables examined job impacts from the view of the program driving the response. The next two tables provide a look at the same employment effects, but displayed by major industry for the west and east sides of the forest.

Table 3-228. Projected changes in west side employment by major industry by alternative in 2010 (jobs).

Industry	Base Year (2001-2002)	Alternative					
		A	B	C	D-DEIS	D-FEIS	E
Agriculture & Natural Resources	87	9	5	5	7	9	9
Mining	0	0	0	0	0	0	0
Construction	5	0	0	0	0	0	0
Manufacturing	3	1	1	1	1	1	1
Transportation, Information, Utilities	9	1	1	1	1	1	1
Wholesale & Retail Trade	131	6	7	7	7	7	6
Finance, Insurance, & Real Estate	24	1	1	1	1	1	1
Professional & Admin Services	15	1	1	1	1	1	1
Arts, Entertainment, & Recreation	140	6	7	7	7	7	6
Accommodations & Food Service	262	15	17	17	17	17	15
Other Services	26	2	2	2	2	2	2
Government	61	0	0	0	0	0	0
Total	764	42	40	40	43	45	42
% change	---	5%	5%	5%	6%	6%	6%

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Table 3-229. Projected changes in east side employment by major industry by alternative in 2010 (jobs).

Industry	Base Year (2001-2002)	Alternative					
		A	B	C	D-DEIS	D-FEIS	E
Agriculture & Natural Resources	105	28	18	10	31	29	43
Mining	1	0	0	0	0	0	0
Construction	10	0	0	0	0	0	0
Manufacturing	9	10	7	3	12	11	17
Transportation, Information, Utilities	22	2	2	1	2	2	3
Wholesale & Retail Trade	236	13	13	12	14	14	14
Finance, Insurance, & Real Estate	33	2	2	1	2	2	3
Professional & Admin Services	28	2	2	1	2	2	3
Arts, Entertainment, & Recreation	118	5	6	6	6	6	5
Accommodations & Food Service	418	23	25	25	26	26	24
Other Services	48	4	3	3	5	4	6
Government	124	0	0	0	0	0	0
Total	1,152	90	78	62	101	97	118
% change	---	8%	7%	5%	9%	8%	10%

West side industries most affected by the modest employment changes are Accommodations & Food Service, Wholesale & Retail Trade, and Agriculture & Natural Resources. The last industry is affected by both tourism and timber, since logging is included in this sector rather than manufacturing. Worland, Greybull, and Lovell may all see portions of these small effects.

East side industries affected are the same as the west, but to a larger degree. Manufacturing is primarily timber processors, but can include miscellaneous secondary effects from tourism. Agriculture & Natural Resources is the largest industry potentially affected by this forest plan decision, but none of the affect is caused by livestock grazing on the Bighorn National Forest. Much of the change includes local secondary effects caused by local residents spending income ultimately obtained from either tourists or firms that process timber. Sheridan, being the largest town and center for both tourism and timber, will experience most of the effects.

The next two tables provide a look at labor income effects by Forest Service resource program for the west and east sides of the forest. As noted earlier, labor income includes all wages and salaries plus benefits for employees and self-employed.

Table 3-230. Projected changes in west side labor income by program by alternative in 2010 (\$ thousand).

Program	Base Year (2001-2002)	Alternatives					
		A	B	C	D-DEIS	D-FEIS	E
Recreation	\$4,560	\$276	\$313	\$313	\$313	\$313	\$276
Hunting & fishing	\$1,571	\$37	\$37	\$37	\$37	\$37	\$37
Grazing	\$2,461	\$0	\$0	\$0	\$0	\$0	\$0
Timber harvest	\$23	\$275	\$168	\$159	\$228	\$263	\$287
Expenditures	\$1,272	\$0	\$0	\$0	\$0	\$0	\$0
Total	\$9,887	\$588	\$518	\$509	\$578	\$613	\$600
% change	---	6%	5%	5%	6%	6%	6%

Table 3-231. Projected changes in east side labor income by program by alternative in 2010 (\$ thousand).

Program	Base Year (2001-2002)	Alternatives					
		A	B	C	D-DEIS	D-FEIS	E
Recreation	\$9,333	\$511	\$580	\$580	\$580	\$580	\$511
Hunting & fishing	\$2,042	\$49	\$49	\$49	\$49	\$49	\$49
Grazing	\$2,543	\$0	\$0	\$0	\$0	\$0	\$0
Timber harvest	\$692	\$1,473	\$982	\$491	\$1,669	\$1,550	\$2,356
Expenditures	\$6,012	\$0	\$0	\$0	\$0	\$0	\$0
Total	\$20,622	\$2,033	\$1,611	\$1,120	\$2,298	\$2,179	\$2,916
% change	---	10%	8%	5%	11%	11%	14%

While job estimates for the west side were dominated by tourism, income estimates are more nearly the same for timber and tourism. Tourism-based income accounts for 70% of all income in Alternative C, but only 50% in Alternative E. Just like employment, tourism-based income is likely to be felt across most communities on the west side, while timber-base income is more likely to be felt primarily in the southern towns.

On the east side, timber-based income exceeds tourism-based income in all but Alternative C. In Alternative D-FEIS, timber-base income is nearly 2.5 times larger than tourism-based. That rate grows to over 4 times larger for Alternative E. As noted above, timber-base income is probably not new income to the area, but founded upon Bighorn timber rather than private sources. Sheridan will realize the greatest portion of income effects among east-side communities.

The next two tables provide a look at the same labor income effects, displayed by major industry for the west and east sides of the forest.

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Table 3-232. Projected change in west side labor income by major industry by alternative in 2010 (\$ thousand).

Industry	Base Year (2001-2002)	Alternative					
		A	B	C	D-DEIS	D-FEIS	E
Agriculture & Natural Resources	\$1,825	\$208	\$121	\$113	\$170	\$198	\$217
Mining	\$19	\$2	\$1	\$1	\$2	\$2	\$2
Construction	\$146	\$6	\$6	\$6	\$6	\$6	\$6
Manufacturing	\$63	\$20	\$19	\$19	\$20	\$20	\$20
Transportation, Information, Utilities	\$326	\$18	\$18	\$17	\$19	\$20	\$19
Wholesale & Retail Trade	\$1,912	\$94	\$100	\$100	\$104	\$105	\$95
Finance, Insurance, & Real Estate	\$330	\$13	\$11	\$11	\$13	\$13	\$13
Professional & Admin Services	\$346	\$15	\$14	\$13	\$15	\$16	\$15
Arts, Entertainment, & Recreation	\$1,070	\$45	\$51	\$51	\$51	\$51	\$45
Accommodations & Food Service	\$2,205	\$134	\$146	\$146	\$146	\$147	\$134
Other Services	\$502	\$30	\$27	\$26	\$29	\$31	\$31
Government	\$1,142	\$3	\$3	\$3	\$3	\$4	\$3
Total	\$9,887	\$588	\$518	\$509	\$578	\$613	\$600
% change	---	6%	5%	5%	6%	6%	6%

Table 3-233. Projected change in east side labor income by major industry by alternative in 2010 (\$ thousand).

Industry	Base Year (2001-2002)	Alternative					
		A	B	C	D-DEIS	D-FEIS	E
Agriculture & Natural Resources	\$2,162	\$847	\$559	\$300	\$938	\$881	\$1,309
Mining	\$46	\$9	\$6	\$4	\$10	\$9	\$13
Construction	\$276	\$11	\$10	\$8	\$12	\$12	\$13
Manufacturing	\$242	\$329	\$226	\$95	\$394	\$357	\$569
Transportation, Information, Utilities	\$606	\$64	\$51	\$35	\$73	\$69	\$94
Wholesale & Retail Trade	\$3,613	\$214	\$209	\$184	\$244	\$238	\$259
Finance, Insurance, & Real Estate	\$807	\$57	\$47	\$34	\$64	\$61	\$79
Professional & Admin Services	\$771	\$56	\$46	\$33	\$63	\$60	\$78
Arts, Entertainment, & Recreation	\$2,321	\$102	\$114	\$113	\$116	\$116	\$105
Accommodations & Food Service	\$4,151	\$240	\$259	\$253	\$266	\$265	\$250
Other Services	\$1,094	\$98	\$79	\$57	\$110	\$105	\$138
Government	\$4,532	\$6	\$5	\$4	\$7	\$6	\$8
Total	\$20,622	\$2,033	\$1,611	\$1,120	\$2,298	\$2,179	\$2,916
% change	---	10%	8%	5%	11%	11%	14%

East-side income effects are felt across all parts of the Sheridan and Johnson County economy. Agriculture & Natural Resources will realize the largest effect, because it gains from both tourism and timber activities. Accommodation & Food Service will reap the next largest set of effects, followed by Wholesale & Retail Trade. Some of these income effects are reaped directly from tourists, but many are the result of local residents spending dollars originating from outside the 4-county area. Again, timber-based income effects are not additional dollars in these estimates but account for the shift of timber sources from private lands to the Bighorn National Forest.

Cumulative Effects

Socio-economic changes in the planning area result when individuals, businesses, governments, and other organizations initiate actions. Millions of decisions will be made by thousands of players over the next decade, all affecting such things as employment, housing, and transportation. Some of these decisions are specifically identified in other parts of this document. For economic and social impact purposes, it is impossible to account for all such decisions separately. Therefore, projections of employment and income to 2010 are used to account for all of these changes. They provide a comprehensive context for considering the effects of Forest management. Projections used in the FEIS were based upon estimates generated by the State of Wyoming (Wyoming Department of Administration and Information, Economic Analysis Division, 2003).

Employment and Income

The following tables show the same employment and income effects displayed above in light of projected growth on both sides of the Bighorn NF. Forest-based tourism dominates the **total** picture on both sides of the mountain, but **changes** to the local economies from Revised Plan decisions are primarily because of changes in timber output.

Table 3-234. Estimated cumulative effects to employment and labor income by alternative for the west side of the Bighorn National Forest (Bighorn and Washakie Counties).

Economic Indicator	2001-2002		Projected West Side and Bighorn NF Totals by Alternative in 2010						
	West Side Total	West Side Forest Total	West Side Total	A	B	C	D-DEIS	D-FEIS	E
Employment									
Total (jobs)	11,754	764	12,506	805	804	804	807	808	806
% of West Side Total	100%	6.5%	100%	6.4%	6.4%	6.4%	6.5%	6.5%	6.4%
Labor Income									
Total (\$ million)	\$338.4	\$9.9	\$393.2	\$10.5	\$10.4	\$10.4	\$10.5	\$10.5	\$10.5
% of West Side Total	100%	2.9%	100%	2.7%	2.6%	2.6%	2.7%	2.7%	2.7%

Table 3-235. Estimated cumulative effects to employment and labor income by alternative for the east side of the Bighorn National Forest (Johnson and Sheridan Counties).

Economic Indicator	2001-2002		Projected East Side & Bighorn NF Totals by Alternative in 2010						
	East Side Total	East Side Forest Total	East Side Total	A	B	C	D-DEIS	D-FEIS	E
Employment									
Total (jobs)	21,218	1,152	23,425	1,242	1,230	1,215	1,253	1,249	1,270
% of East Side Total	100%	5.4%	100%	5.3%	5.3%	5.2%	5.3%	5.3%	5.4%
Labor Income									
Total (\$ million)	\$597.5	\$20.6	\$694.9	\$22.6	\$22.2	\$21.7	\$22.9	\$22.8	\$23.5
% of East Side Total	100%	3.5%	100%	3.3%	3.2%	3.1%	3.3%	3.3%	3.4%

If projections made by the state of Wyoming bear out, the contribution that use and management of the Bighorn National Forest has in the area economy is expected to decrease very slightly by 2010. The forest contribution on both sides of the mountain will remain almost unchanged in terms of both jobs and income. The small changes in contribution for Alternatives A, D-DEIS, D-FEIS, and E are negligible. The changes in contribution for Alternatives B and C are somewhat larger, but still very small. While the contribution of the Bighorn National Forest to the local economies may drop, the total effect of the forest will increase. These increases are expected to grow at a rate that is slower than the overall growth rate for the west and east sides, respectively. New jobs and income from other economic engines are expected to exceed any growth attributable to the Bighorn National Forest.

Whatever change may be felt by communities in the 4-county area, Sheridan County will experience the most. These effects will locate in Sheridan because of its size and because of the timber industry in Sheridan. All four counties have a tourism economic component, and all will see a gradual increase in economic activity as tourism continues to grow in the area.

A reasonably foreseeable activity that will cause a significant change in the employment and income of Sheridan and Johnson Counties is coalbed methane development. The BLM Powder River Basin EIS projected that at the peak construction time of 2007, over 5,760 workers would be needed in Sheridan, Johnson, Campbell, and Converse Counties. Currently, it appears that the BLM permitting process is proceeding slightly more slowly than was anticipated, so that peak may be later than 2007. These are typically high-paying jobs, with considerable amounts of overtime.

Demographics

Population trends often follow economic trends. For example, as jobs are created, those in search of employment move into an area. Projections, as shown earlier in this section, suggest that there are no known events that would cause a major change in the current trajectory of Big Horn and Washakie Counties' population trends. Those counties have either had stable populations over time, or depending on the time period considered, have had small decreases. On the other hand, it is likely that the Johnson and Sheridan Counties' populations will increase over the next decade, primarily due to coalbed methane activity. This employment effect of the coalbed methane project is expected to last until about 2018. The small change that Bighorn National Forest activities are projected to have suggests that the Forest will not be a major player in affecting population trends regardless of the alternative.

Environmental Justice

Environmental justice examines the effects of land management decisions in light of minority and low income populations. There is no indication that these populations will experience a disproportionate share of social and economic effects caused by any of the alternatives considered here.

Financial and Economic Efficiency

Both financial and economic efficiency are analyzed in this section. Financial efficiency examines revenue and cost implications from the perspective of the Forest Service. It could also be said that this is the perspective of the taxpayer. Only those revenues and costs that are recorded in financial records are included in this analysis.

Economic efficiency examines a broader definition of benefits by including values for national forest uses that are not captured in the marketplace. Willingness-to-pay values for recreation use are the primary additions over a financial analysis. Estimated market value for meat gained by grazing livestock on public land is also included. Water values have been excluded from this analysis, because past and planned activities on national forests in the Rocky Mountain Region have not approached intensities needed to increase water yield. This is documented in the water yield analysis of FEIS Appendix B. Appendix B also includes a complete description of values used in the financial and economic analyses.

Many non-market, non-use values are excluded from this economic efficiency analysis. Some outcomes or effects, such as biological diversity, visual amenities, bequest values, existence values, and some social impacts have no monetary values or costs that have been established by USDA or the Forest Service. While some research studies have explored the development of such values, it is reasonable to handle these items in a non-monetary fashion. This is done in other sections of this EIS. The agency cost of achieving these non-monetary outputs is included in both the economic and financial analyses.

Net public benefit is an important concept for carrying out a forest plan revision. Net public benefit is defined as the overall value to the nation of all outputs and positive effects (benefits) minus all the associated Forest Service inputs and negative effects (costs) for producing those primary benefits, whether they can be quantitatively valued or not. Thus, net public benefits conceptually are the sum of this economic analysis *plus* the net value of nonpriced outputs and costs. It is not the result of an economic analysis alone. This concept is the basis upon which the Regional Forester selects an alternative for implementation.

The main criterion used in assessing financial and economic efficiency is *present net value* (PNV), which is defined as the value of discounted benefits (or revenues) minus discounted costs. A PNV analysis includes all outputs, including timber, grazing, and recreation, for which monetary values are assigned. As noted above, the monetary values include both market and nonmarket values received by the public.

In addition, a financial efficiency analysis is completed to determine the net financial returns of each alternative. A financial efficiency analysis is the PNV of Forest Service revenues and costs. The following table displays the economic and financial PNV for each alternative. All monetary values are expressed in constant dollars with no allowance for inflation. A 4% discount rate was used over a 50-year period (2006 to 2055). Revenues are not reduced for payments made to states and counties. The reduction of PNV in any alternative as compared to the most financially or economically efficient solution is the economic trade-off, or opportunity cost, of achieving that alternative.

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Table 3-236. Economic and financial efficiency by alternative (present value over 50 years in millions of 2003 dollars).

Revenue/Cost	Alt. A	Alt. B	Alt. C	Alt. D-DEIS	Alt. D-FEIS	Alt. E
Forest Service revenues	\$12.0	\$10.0	\$7.8	\$13.2	\$12.5	\$16.1
Forest Service costs	\$238.0	\$238.0	\$238.0	\$238.0	\$238.0	\$238.0
Society benefits	\$853.9	\$852.3	\$850.1	\$855.4	\$854.8	\$858.0
Financial net revenues	-\$226.0	-\$228.0	-\$230.2	-\$224.8	-\$225.5	-\$221.9
Economic net benefits	\$615.9	\$614.2	\$612.1	\$617.4	\$616.7	\$620.0
Difference from highest econ net benefit (Alt E)	-\$4.1	-\$5.8	-\$7.9	-\$2.6	-\$3.3	---

As shown in the table above, financial PNV (Forest Service revenues minus Forest Service costs) varies from a low of -\$230.2 million for Alternative C to a high of -\$221.9 million for Alternative E. In all cases, Forest Service costs exceed revenues. What makes Alternative E the highest financial PNV is high timber harvest levels and associated revenues. Alternatives with preservation emphases, such as Alternative C, show the greatest net cost to the taxpayer, because there are no agency revenues associated with these emphases to offset similar levels of expense.

The economic PNV (society benefits minus all costs) ranges from a low of \$612.1 million for Alternative C to a high of \$620.0 million for Alternative E. The net economic benefits are orders of magnitude larger than the financial gross revenues. This suggests that even with the limited monetary values available for this analysis, society benefits greatly from implementing any alternative fully considered in this document. Most of the benefits are attributable to the value of recreation use.

There are relatively small changes in economic net benefits between alternatives. These changes are largely attributable to the timber program. The reduction in PNV for any alternative other than Alternative E must be weighed against the non-priced values (outcomes) achieved in those alternatives. To select an alternative other than E, the decision-maker must determine that achieving non-priced outcomes and resource conditions are worth the additional net cost to the public. This discussion can be found in the Record of Decision.

Local Governments

AFFECTED ENVIRONMENT

An important aspect of a county's economy is the financial capacity of county government. This is important since it determines the ability of the county to provide local government services and maintain public infrastructure. The following discussion includes the Wyoming counties of Big Horn, Johnson, Sheridan, and Washakie.

County Revenues

Federal Land Payments

The following discussion considers two aspects of county government revenues that could be directly or indirectly related to activities on the Bighorn National Forest: 1) Federal land payments and 2) receipts from assessed property and sales taxes. Four counties contain lands within the Bighorn National Forest – Big Horn, Johnson, Sheridan, and Washakie. Counties that contain National Forest System lands receive payments from the federal government to generally compensate for two costs. The first cost is that borne by local governments for serving visitors to the national forests (compensated by the 25% Fund). A general relationship between land location and visitor use is implied in enabling legislation, but the level of actual visitor use is not a factor in the formula. The second cost is the loss of property tax revenues (compensated by Payment in Lieu of Taxes (PILT) payments). These payments may or may not compensate counties fully for property taxes lost because of Federal ownership.

Forest Payments

The Act of May 23, 1908 (as amended) required payments equal to a 25% share of annual revenues coming from the sale of forest products, user fees, and special use permits (such as grazing) on each national forest. These payments were made to states, then distributed to the counties, with the restriction that they could be expended only on education or roads. The remaining 75% was not retained by the Forest Service, but rather deposited in the U.S. Treasury. These 25% Fund payments were not limited by annual congressional appropriations.

The Secure Rural Schools and Community Self-Determination Act of 2000 provided counties with an additional payment option. The new law offered counties an option for payments that do not fluctuate with national forest revenues. Fixed amounts based on recent history unlink these payments from changing uses and revenues of a national forest. Under this option, counties receive the average of the three highest 25% Fund payments during the period of fiscal years 1986 through 1999. This option provides stability of payments but removes the opportunity for larger payments. The fixed amounts have additional requirements for their use. Counties had until September 30, 2001, to decide whether they would continue with annually varying 25% Fund payments for choose fixed amounts. All of the four counties that have public lands managed by the Bighorn National Forest have elected the fixed payment option. The following table shows the payments received by each county in 2004.

Payment in Lieu of Taxes (PILT) payments

Payment in Lieu of Taxes (PILT) is a payment determined by formula in the Payments in Lieu of Taxes Act of 1976. PILT is a federal revenue-sharing program administered by the Bureau of Land Management that is designed to compensate local governments for the presence of tax-exempt federal lands within their jurisdictions. The formula takes into account such factors as other forms of revenue sharing, acreage, and population. These

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payments are made directly to counties and may be used for any purpose. PILT payments can be and recently have been limited by Congress through the appropriations process. Congress has not appropriated sufficient funds to fully pay counties since 1994. Federal land payments for the most recent year available are shown in the following table.

Table 3-237. Federal land payments and total revenues for Bighorn National Forest counties, 2004.

County	PILT	Forest Payments	Total Revenues	Percent Total Federal Land Payments of Total Revenues
Sheridan	\$570,460	\$106,773	\$13,667,504*	5.0%
Big Horn	\$641,615	\$95,258	\$6,895,906	10.7%
Johnson	\$521,558	\$88,663	\$5,336,332	11.4%
Washakie	\$605,982	\$9,735	\$5,078,245	12.1%

*Excludes county hospital

Source: Wyoming Department of Revenue, USDI-PILT web page, and USDA Forest Service.

Federal land payments are an sizable source of revenue for all counties, exceeding \$600,000 for each in 2004. These payments are especially important for Big Horn, Johnson, and Washakie Counties, constituting more than 10% of total county revenues.

Sales and Lodging Tax Revenues

Since 1994, the state imposed sales tax rate in Wyoming has been 4%. The revenue from sale tax collections are distributed between state and local governments with 72% allocated to state government and 28% returned to local government in the county of origin. The local government share is allocated between the county and towns based on population. Wyoming counties also have the option of imposing an additional 1% sales tax through public election. The optional sales tax revenue, less administrative costs, is returned to the county of origin. In addition, Wyoming counties may also impose a second 1% sales tax, which must be designated for specific, pre-defined, capital improvements.

Cities, towns and counties in Wyoming may impose an excise tax of up to 4% on all sleeping accommodations for guests staying less than 30 days. This tax extends to mobile accommodations such as tents, trailers, and campers, as well. At least 90% of the tax distributions must be used to promote travel and tourism within the county, city or town imposing the tax. The amount remaining, not to exceed 10% of the total amount distributed, may be used for general revenue within the governmental entity imposing the tax. Washakie and Johnson Counties have imposed a lodging tax countywide. In Big Horn and Sheridan Counties, only the cities of Lovell, Greybull, and Sheridan have a lodging tax. The following table shows a summary of sales and lodging taxes collected within the planning area.

Table 3-238. Sales and lodging tax collections by county, 2000-2003.

Measure/Jurisdiction	2000	2001	2002	2003
Total Sales Tax Revenues				
Big Horn - County	\$724,523	\$781,988	\$848,228	\$865,833
Big Horn - Towns	\$1,257,694	\$1,357,450	\$1,434,148	\$1,393,989
Big Horn Total	\$1,982,217	\$2,139,438	\$2,282,376	\$2,259,822
Washakie - County	\$347,537	\$360,626	\$407,656	\$470,508
Washakie - Towns	\$900,916	\$934,848	\$827,832	\$865,172
Washakie - Total	\$1,248,453	\$1,295,474	\$1,235,488	\$1,335,681
Johnson - County	\$699,071	\$811,620	\$1,023,449	\$1,056,806
Johnson - Towns	\$1,178,461	\$1,368,190	\$1,451,058	\$1,440,557
Johnson - Total	\$1,877,532	\$2,179,810	\$2,474,507	\$2,497,363
Sheridan - County	\$5,716,680	\$6,422,643	\$7,231,508	\$7,320,572
Sheridan - Towns	\$4,508,374	\$5,060,736	\$5,738,868	\$5,787,112
Sheridan - Total	\$10,225,054	\$11,483,380	\$12,970,376	\$13,107,684
Travel Sales Tax Revenues				
Big Horn County/Towns	\$580,000	\$595,000	\$600,000	\$595,000
Washakie County/Towns	\$360,000	\$344,000	\$352,000	\$368,000
Johnson County/Towns	\$915,000	\$925,000	\$980,000	\$960,000
Sheridan County/Towns	\$2,598,000	\$2,664,000	\$2,676,000	\$2,736,000
Share of Sales Tax Generated by Travel				
Big Horn County/Towns	29.3%	27.8%	26.3%	26.3%
Washakie County/Towns	28.8%	26.6%	28.5%	27.6%
Johnson County/Towns	48.7%	42.4%	39.6%	38.4%
Sheridan County/Towns	25.4%	23.2%	20.6%	20.9%
Lodging Tax Revenues				
Big Horn (Lovell & Greybull)	\$19,690	\$19,017	\$18,698	\$18,438
Washakie County/Towns	\$28,519	\$29,237	\$27,500	\$28,569
Johnson County/Towns	\$79,422	\$91,807	\$90,376	\$97,203
Sheridan (Town of Sheridan)	\$173,425	\$170,336	\$173,508	\$174,554

Sources: State of Wyoming, Department of Revenue and Wyoming Department of Administration and Information, Economic Analysis Division.

County Assessed Valuation

The following tables shows each county's assessed valuation. The assessed valuation is the basis for tax revenue a county can generate. That is, state law allows a county to tax, up to a certain specified rate, the assessed property values, so the total amount of receipts a county is able to generate is directly proportional to its assessed valuation. County tax receipts fund basic services, such as roads, infrastructure, and law enforcement. County tax

revenue can also fund economic development agencies or authorities, and could provide incentives for business relocation through business park development or partial infrastructure development. A county with the level of income high enough to be able to afford these types of development services is in a position to help compensate for the inevitable social and economic changes that western, rural communities undergo.

Table 3-239. County assessed valuation for FY 2004.

	Assessed Valuation	Average County Levy (mills)
Sheridan	\$384,625,834	68.061
Big Horn	\$157,856,465	75.858
Johnson	\$155,186,606	67.250
Washakie	\$92,839,776	72.092

Source: Wyoming Department of Revenue

County Costs

As population increases occur, private development often increases near National Forest boundaries. Homes situated adjacent to the National Forest boundary typically offer more privacy, better views, greater opportunities for recreation and wildlife viewing, and more pleasant immediate surroundings than might be available further away from public lands. These amenities are highly valued by homeowners, but with these developments come higher costs of services by local governments. Irregular boundaries, less-developed roads, and longer distances from community centers make for expensive law enforcement, public schools, and emergency services.

The costs borne by local governments for serving visitors to the National Forests includes law enforcement and judicial services, rescue and other emergency services, and wear on local public infrastructures (such as parks, streets, and water and sewer systems).

County Road Maintenance

Two roads crossing the Forest fall under county jurisdiction. Few Forest roads serve as primary through-routes that connect communities, but several are used by communities for recreation and commercial access. Among these roads are:

- ♦ Big Goose Road, Sheridan County. Accesses the Dome Lake and other nearby reservoirs on private land inholdings. Currently, Bighorn National Forest is maintaining this road.
- ♦ Hazelton Road, Johnson County. Accesses private, BLM, and state land south and southeast of Bighorn National Forest.

Land Use

Land ownership

The following tables show the landownership patterns in the four counties and the county acres on the Bighorn National Forest, respectively. Only about 20% of Big Horn County is

in private ownership. In contrast, 65% of Sheridan and 60% of Johnson counties are in private ownership.

Table 3-240. Percent of landownership by county.

County	National Forest System	BLM	Other Public	Private
Sheridan	24.3%	3.0%	7.9%	64.8%
Big Horn	17.4%	54.2%	8.4%	20.0%
Johnson	12.2%	19.1%	8.9%	59.8%
Washakie	2.5%	66.1%	7.2%	24.2%

Table 3-241. Bighorn National Forest system lands by county.

County	Area of Bighorn NF within County	% of Bighorn NF in County
Sheridan	393,627	35%
Big Horn	351,153	32%
Johnson	326,881	30%
Washakie	36,003	3%

Development and Subdivisions

The conversion of agricultural land to rural residential development is a widespread phenomenon in many counties adjacent to National Forests. Increased demand for rural subdivisions, especially in Sheridan and Johnson counties, not only has taken land out of open space and agricultural production but has increased land values for remaining agricultural land. This can lead to more land taken out of agricultural production as the cost of taxes increases and because of the money that can be made by selling the land. The table below shows the amount of land in each county taken out of agricultural production or “developed” between 1982 and 1997 and compares that to the population change over the period. In each county, while the population actually declined over that period, the amount of developed land in each county increased. Data for 1997 is the most recent for land use changes.

Table 3-242. Change in developed land and population by county, 1982-1997.

County	Change in Developed Land 1982-1997	Change in Population 1982-1997
Washakie	34.1%	-15.9%
Sheridan	11.0%	-1.1%
Big Horn	9.8%	-12.0%
Johnson	6.5%	-4.2%

A recent study by the American Farmland Trust (2002) estimates that 11% of all prime ranchland (those with rural development densities, located near public lands, year-round water availability, mixed grass and tree cover, and a high variety of vegetation classes) are

threaten by conversion to residential development. In Wyoming, the Trust estimates that 2.6 million acres of ranchland are at risk. Many of these ranches hold federal livestock grazing permits.

A shift away from ranching or farming practices, including grazing on public lands, would affect wildlife grazing and migratory patterns of elk and deer. In addition, without federal leases, the grass on the private base property would be used more intensively for domestic cattle operations, with little left over for wildlife, particularly in the winter. Wildlife access is provided for on large tracts of open range.

One of the concerns associated with this type of conversion is that it may cause financial problems for local governments and schools. Numerous studies from across the country have indicated that the conversion of agricultural land to residential use is a net fiscal loss to county taxpayers. While tax revenues typically increase from such conversion, the increase is generally more than offset by the increase in expenses.

Land Use Planning

The Revised Plan has a strategy that states, “Recognize and coordinate with County Land Use and Conservation District Plans as part of Forest management activities.” These local governments have participated in the forest plan revision process as Cooperating Agencies. County Commissioners and Conservation District board members have met with forest plan revision personnel on over 35 occasions since 2001 and have had an opportunity to comment on Revised Plan direction and alternatives.

The County Plans were used as a criteria in discussions regarding Forest alternatives. Forest personnel reviewed these plans, and believe that all forest plan alternatives are consistent with the County and Conservation District Plans. There is a disagreement between Washakie County and forest personnel over how specifically the Revised Plan should address the need for a restroom facility along U.S. Highway 16.

ENVIRONMENTAL CONSEQUENCES

Direct and Indirect Effects

Revenues to Counties

Because all of the counties containing NFS lands have elected to receive the full payment amount, Forest and PILT payments are now independent of Forest outputs. Tourism tax revenues are expected to increase over the next planning period due to increased tourism caused by national demographic changes and growth of the national economy. Sales and lodging tax revenues associated with tourism may change very slightly depending upon the alternative. Given the expected growth in tourism and the rough approximations with which such estimates are made, changes in tax revenues may be imperceptible between Alternatives B, C, D-DEIS, and D-FEIS and Alternatives A and E (less than 0.6%).

County Costs and Land Use

There has always been interplay between public and private land management decisions in communities and jurisdictions in the rural West. Federal land management decisions can affect local landowners, business owners, and local governments. Conversely, these same parties can affect the use and management of federal lands. Two loci where such relationships might be affected by the Bighorn forest plan revision are 1) potential changes to the agriculture industry and 2) potential changes to private land development.

Van Tassell and Richardson (1998) have shown that locally sizable reductions in federal grazing can significantly affect the viability of ranching operations in Wyoming. Such losses could enhance the rate at which agricultural lands are developed for residential and second-home uses. Van Tassell and Richardson note that "...because of the price most land around national forests can demand, the danger is those lands would be subdivided into ranchettes or other residences rather than stay in productive agricultural use." However, none of the alternatives anticipate changes in grazing outputs as a result of forest plan revision decisions, so there should be no direct effect upon ranch operations viability.

As land subdivision continues to occur due to non-National Forest influences, local governments could expect an increase in the net cost of services. Coupal, McLeod, and Taylor (2002) projected the effect of land use change on the fiscal condition of counties throughout Wyoming. They found that "...rural residential development costs more to taxpayers than it contributes in revenues; and conversely, that agricultural land contributes more to county coffers than it asks for in services."

Trends in rural residential development are expected to continue in Wyoming apart from any change in the Revised Plan. Areas where development on private lands adjoins the National Forest boundary can raise special problems related to wildfire and local government services. The specialized management of adjoining National Forest System lands is one way that the Forest Service and local governments can collaborate on solutions for these unique problems. Community Wildfire Protection Plans, as authorized in the Healthy Forest Restoration Act, are a likely collaborative vehicle for National Forest land managers and the owners of non-federal adjoining lands. This management collaboration has been applied on the Bighorn National Forest, most notably near and in Story, Wyoming. The more effective these collaborative efforts and fuels reduction efforts, the more likely there will be potential cost savings or increased effectiveness of services. This is not expected to vary by alternative since wildland urban interface fuels will be treated under all the alternatives.

Cumulative Effects

Cumulative effects analysis considers the consequences of the alternatives in concert with the consequences of other actions. Twenty-five Percent Fund payments would not be affected by these actions. Although PILT payments would not be affected by the amount in Forest receipts, PILT can be affected by changes to county populations. None of the revision actions analyzed in this DEIS would substantively alter the population growth

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anticipated for the planning area. PILT is likely to increase in Sheridan and Johnson counties, because of the population increases anticipated from coalbed methane activity.

As stated above, second homes and other rural residential development will likely continue independent of decisions made in the Bighorn forest plan revision. These changes are most likely to occur in Sheridan and Johnson counties, largely because of the availability of non-federal lands compared to the west-side counties. County assessed valuation based on property values will correspondingly increase, as will county costs to cover the increased costs of rural subdivisions compared to agricultural land. Decisions made in the Bighorn forest plan revision are not expected to increase or decrease trends in private land use or county costs.

Potential Conflicts with Goals/Objectives of Other Agencies

The Forest has coordinated with various federal, state, and local agencies in the formulation of alternatives; development of goals, objectives, standards, and guidelines; and other important aspects of the revision process. Consultations included American Indian tribes; the Bureau of Land Management; U. S. Fish and Wildlife Service; Wyoming Game and Fish Department; county governments; Conservation Districts; and other local, state, and federal agencies. County Land Use and Conservation District Annual Plans were also reviewed. For a complete list of agency coordination, please see Chapter 5 of the FEIS. The administrative record, located at the Forest Supervisors office in Sheridan, WY, contains proceedings of the coordination efforts.

Alternatives, associated effects, Forestwide standards and guidelines, and management area prescriptions are generally compatible and compliment the goals and objectives of land management agencies adjacent to or near the Forest. The following summary is provided to help define areas of potential differences between the Forest Service policies, management, and responsibilities and those of other agencies.

- ◆ **Mining** – the U.S. Mining Laws Act of 1872 predates all other laws that govern Forest Service activities. Mitigating effects from mining activities could result in conflicts with federal mining laws. Conflicts could arise between the mining activities allowed under the act and other resources, such as scenery, water, sensitive plants and animals, or recreation.
- ◆ **Water resources** – federal requirements and authorities for maintenance and protection of water resources may conflict with the state of Wyoming’s administration of water rights.
- ◆ **Big game hunting** – the Forest is cooperating with the Wyoming Game and Fish Department to investigate potential declines in big game hunting opportunities on the Forest. Increasing road densities and reductions in cover may be partially responsible for elk and other big game leaving the Forest prior to the fall big game hunting season.
- ◆ **Restroom facility along U.S. Highway 16** – the Draft Revised Washakie County Land Use plan states that [federal land use plans] are incomplete and materially deficient unless they contain a thorough discussion and evaluation of the need for public sanitary facilities along transportation corridors in the county. The Forest has maintained that the Revised Forest Plan will allow for construction of such a facility, but it is not the proper decision level for this type of facility. In addition, the Forest has resisted taking the lead for the construction and maintenance of such a facility since the Forest does not have sufficient budget to adequately maintain existing recreation facilities.

Resource Commitments

Energy Requirements for Implementing the Alternatives

Energy is consumed in the administration and use of natural resources from the Forest. For purpose of the Revised Plan, energy sources are gasoline, diesel fuel, liquefied petroleum, natural gas, electricity, and wood. The Forest is currently installing a fuel cell (a renewable energy source) at the Big Goose Ranger Station. Although many activities consume energy, the following are considered important in the implementation of any alternative:

- ◆ Energy consumption related to recreation is the amount required for visitors to get to and around the Forest, and for administrative purposes. The amount used is based on the number of dispersed and developed recreation visitor days, estimated trip lengths, and facility construction.
- ◆ Energy consumed in timber harvesting is the amount required for felling, bucking, skidding, loading, hauling, for performing road maintenance, and for the industrial traffic associated with harvest activities.
- ◆ Energy consumed in utilizing range vegetation is the amount required for hauling stock to and from the range and for permittee range improvement activities (watering, salting, and herding).
- ◆ Energy consumed in road construction and reconstruction activities is that used by contractors or Forest Service crews in completing road development.
- ◆ Energy consumed by Forest Service administrative activities includes vehicle use; lighting and heating of buildings; and fuel used in such equipment as small engines and burners.

Unavoidable Adverse Effects

The application of Forestwide standards and guidelines and resource protection measures would limit the extent and duration of any adverse environmental effects. Nevertheless, some adverse effects are unavoidable. Adverse effects for one source may be a beneficial effect for another. For example, timber harvest may adversely affect the habitat for species that need mature, large trees while at the same time increasing the amount of habitat for species that need early successional habitat. For a detailed discussion of all effects, including unavoidable adverse effects, see the Environmental Consequences discussions for each resource area: air, biological diversity, recreation, minerals, etc.

Relationship Between Short-term Uses of the Environment and Long-term Productivity

Short-term uses are those expected to occur on the Forest over the next ten years. These uses include, but are not limited to, recreation, grazing, mineral development, timber

harvest, and prescribed burning. Long-term productivity refers to the capability of the land to provide resource outputs for a period of time beyond the next ten years.

The minimum management requirement established by regulation 36 CFR 219.27 provides for the maintenance of long-term productivity of the land. Minimum management requirements prescribed by the Forestwide standards and guidelines will be met under all alternatives. Minimum requirements assure that long-term productivity of the land will not be impaired by short-term uses.

Monitoring, described in Chapter 4 of the Revised Plan, applies to all alternatives. One purpose of monitoring is to assure that the long-term productivity of the land is maintained or improved. If monitoring and subsequent evaluation indicates that Forestwide standards and guidelines are insufficient to protect long-term productivity, the Revised Plan will be amended accordingly.

Although all the alternatives were designed to maintain long-term productivity, there are differences between alternatives in the long-term availability or condition of resources. There may also be differences between alternatives in the expenditures necessary to maintain desired conditions.

Irreversible and Irretrievable Commitment of Resources

Irreversible and irretrievable commitments of resources are defined in Forest Service Handbook 1909.15 (2/21/95).

The **irreversible commitment** of resources means that nonrenewable resources are consumed or destroyed. Examples include mineral extraction, which consumes nonrenewable minerals, and potential destruction of such things as heritage resources by other management activities. These consumptions or destructions are only renewable over extremely long periods of time.

The **irretrievable commitment** of resources are opportunities foregone. They represent trade-offs in the use and management of forest resources. Irretrievable commitment of resources can include the expenditure of funds, loss of production, or restrictions on resource use.

Decisions made during the forest planning process do not represent actual irreversible or irretrievable commitments of resources. They merely determine the kinds and levels of activities that are appropriate on the Forest. Additionally, a forest plan does not make site-specific or project decisions. A decision to irreversibly or irretrievably commit resources occurs:

- ◆ When the Forest Service makes a project- or site-specific decision.
- ◆ At the time Congress acts on a recommendation to establish a new wilderness or to include a river in the Wild and Scenic River System.

Examples of irretrievable resource commitments associated with Revised Plan decisions are as follows:

- ◆ Commodity outputs and uses (such as motorized recreation) are curtailed or eliminated in areas recommended for, and subsequently designated as, wilderness, Wild and Scenic Rivers, Research Natural Areas, and some Special Interest Areas.
- ◆ Opportunities for nonmotorized recreation, solitude, and primitive or wilderness experiences are foregone if portions of the Forest are not allocated or recommended for these purposes.
- ◆ Timber volume outputs would be foregone on lands determined not suitable for harvest.
- ◆ Commodity outputs are reduced or foregone on areas allocated to specific uses or purposes, such as developed recreation sites, old growth habitat, or botanical areas.
- ◆ Non-commodity values such as scenic resources may be reduced or foregone in areas allocated to commodity uses.
- ◆ To the degree that an alternative preserves or encourages the development of mature and old-growth habitat, opportunities to develop early successional habitat are reduced.
- ◆ The Record of Decision that accompanies the Revised Plan will authorize the Bureau of Land Management to lease certain portions of National Forest System lands based on the leasing analysis in the final EIS and subject to the leasing stipulations in Appendix B of the Revised Plan. Although surface disturbance cannot occur on leased land without further NEPA analysis and decision-making, issuance of a lease confers certain rights on the lessee and represents a commitment of resources. The effects of the exploratory and developmental wells on lands with low oil and gas development potential were analyzed and disclosed in all alternatives.